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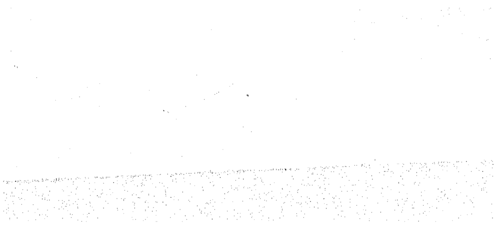


The Empire Cotton Growing Review

Journal of the Empire Cotton Growing Corporation

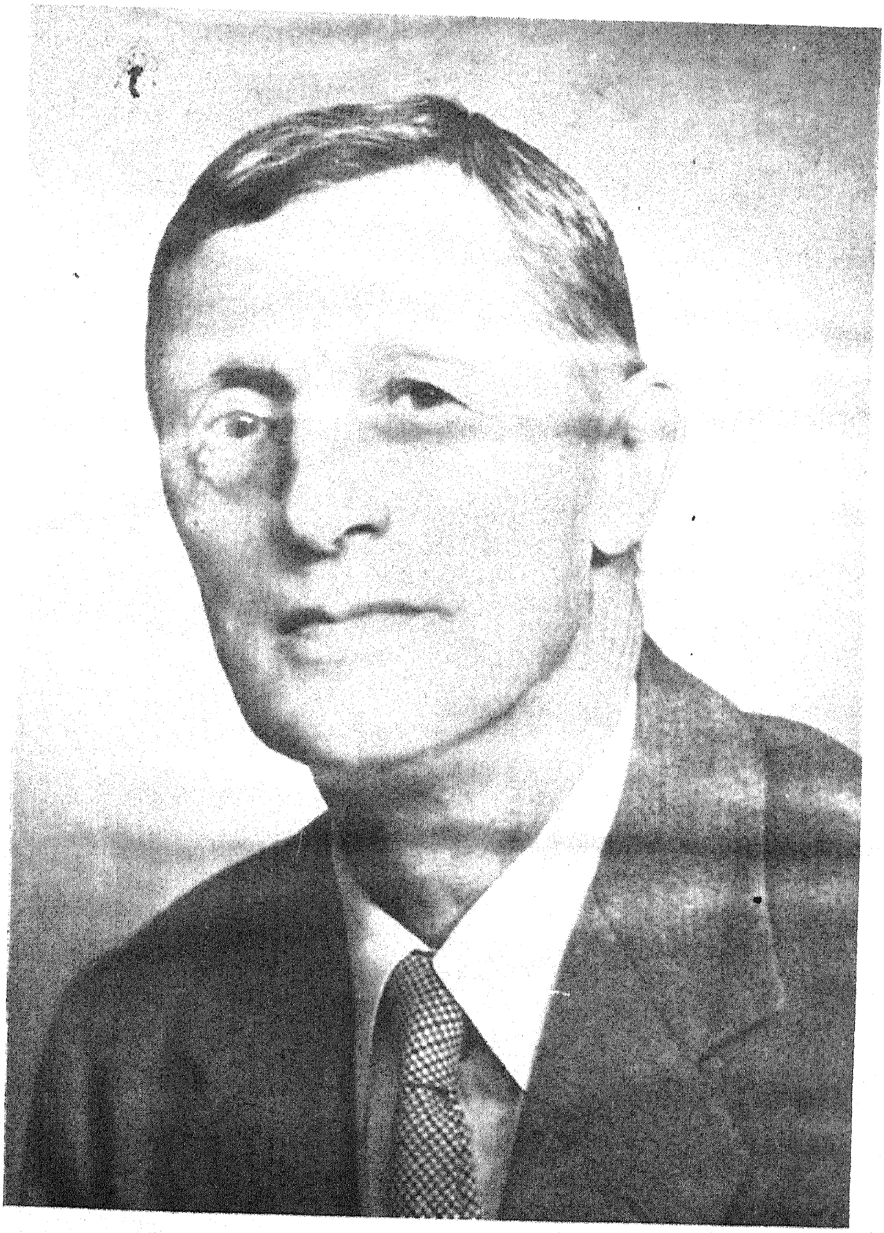
Vol. XXVII.

INCORPORATED
BY ROYAL CHARTER
1ST NOVEMBER
1921

1950

Edited by
W. Nowell, C.M.G., C.B.E.

Published on behalf of
The Empire Cotton Growing Corporation
by Staples Press Ltd., 14, Great Smith St., London, S.W.1
PRICE: 1s. 3d. per copy post free.



MR. F. R. PARNELL

THE
EMPIRE COTTON GROWING
REVIEW

VOL. XXVII JANUARY, 1950 No. 1

RETIREMENT OF MR. F. R. PARNELL

MR. PARNELL, the head of the Cotton Experiment Station at Barberton from its start in 1924, the Corporation's senior officer in Africa since Mr. Milligan's retirement in 1935, and the first Director of the Central Research Station at Namulonge, in Uganda, retired from the Corporation's service last November.

Mr. Parnell came to the Corporation from India, where he had already won a high reputation as a plant breeder, in order to take charge of the cotton breeding which the Corporation had agreed to undertake for South Africa. He very soon realized that the urgent need of the country's new cotton-growing industry was a variety resistant to jassid attack, and in a remarkably short time he produced by selection a strain which successfully met the need. That strain, U.4, is familiar to all who are connected with cotton in Africa, and to many elsewhere, not only because it is one of the most striking examples known of resistance to a pest, but also because it had the additional qualities of adaptability, earliness and fruitfulness which have spread it far and wide in Africa.

From very modest beginnings the Station at Barberton developed under Mr. Parnell's leadership into the largest of those controlled by the Corporation, studying problems over a wide field in cotton breeding and cultivation, rotation crops, pests and diseases. At its peak, before the last war, the research staff totalled eleven workers whose programme, particularly as regards insect pest investigation, was linked with the programmes of the Stations in Swaziland, Southern and Northern Rhodesia and Nyasaland.

Early in 1939 the Scientific Committee, with Mr. Parnell's help, reviewed the Corporation's scientific policy, and it was decided to concentrate the research in progress in Trinidad and at Barberton at a new Station in a country where cotton was an important economic crop, probably Uganda.

This proposed reorganization was delayed by the war, and Mr. Parnell used the intervening years in working, with a staff reduced to a minimum by the claims of war service, on the production of high quality, jassid-resistant strains by a comprehensive programme of inter-specific crosses.

When the Corporation decided that the moment had arrived to transfer their South African and Trinidad resources to Uganda, they turned naturally and inevitably to Mr. Parnell to organize and to establish the new station which should serve as the new headquarters for their research. This meant that Mr. Parnell had to lay aside plant breeding, to which he had devoted so much energy and in which he had been so successful, in order first to select a suitable site in a new country, and then to plan, build and equip a large new station upon it. Mr. Parnell accepted this duty and has discharged it with the thoroughness and care of detail which he has shown in everything to which he has set his hand. He has accomplished the task at a time of life when many men might have been justifiably content to rest on their laurels, and what is more, he has achieved it in the face of shortage of labour and of supplies of every sort, and of the need for endless financial contriving, amidst steadily rising costs. The Station today bears testimony to his success.

But Mr. Parnell's contribution to the Corporation's work, and to the wider field of agricultural research generally in Africa, cannot be measured only by the two stations which he has created or by his own achievement in cotton breeding, sufficiently substantial though these be. His influence extends beyond this, and will certainly continue in the minds of all those who have come in contact with him and sought his advice, most of all those who have had the privilege of working with him.

Departure from Barberton meant leaving not only a station, but also a home. What this can have meant to Mrs. Parnell only those can realize who have enjoyed the kindly and generous hospitality of her home at Barberton. She could not bring that physical home with her to Uganda, but she brought its essence, and everyone, perhaps especially the children, will be sad that they have had to say good-bye.

Unhappily, the hard and anxious work of the last few years has not been without an effect on Mr. Parnell, who had to spend a part of his last few weeks in Uganda in hospital. Everybody will wish him a complete recovery, and for him and his wife every sort of happiness in a retirement which could hardly have been more strenuously earned, or better deserved.

Central Research Station, Namulonge

Mr. F. R. Parnell retired on November 15, 1949. His position as Director of the Namulonge Research Station has been filled by the appointment of Dr. J. B. Hutchinson, C.M.G., the Deputy Director, formerly Head of the Genetics Section of the Cotton Research Station, Trinidad, and Cotton Adviser to the Inspector General of Agriculture for the West Indies. Dr. Hutchinson has accordingly moved to Namulonge from Shambat in the Sudan, where he has been carrying on his genetics work since the closing of the Trinidad Station.

SIR ROBERT PICKARD

MANY of the readers of the REVIEW will have noted in the Press the report of the death of Sir Robert Pickard in October last, and all who did so will have heard the news with sincere regret.

Tributes to his work have already been paid in the leading daily papers and scientific journals, but it remains for us to place on record the value of the services which he rendered to our Corporation.

When Dr. A. W. Crossley died, in 1927, Sir Robert was invited to succeed him as the representative of the Shirley Institute on the Corporation's Scientific Committee. In spite of the very many calls on his time from other bodies, Sir Robert not only accepted the Corporation's invitation, but during the twenty years for which he remained a member of the Committee it was very seldom that he missed a meeting.

By retaining the link between the Corporation's research work and that of the Shirley Institute, Sir Robert's membership of the Committee was invaluable. It was frequently a matter of some amusement to his colleagues that he was at pains to point out that biology was not his subject and that he spoke as a layman in such matters; but he almost invariably followed up such an introduction by putting his finger unerringly on some point on which technological tests at the Shirley Institute on samples submitted by the Corporation's plant breeders might throw further light on the problem under discussion. Through Sir Robert's good offices the resources of the Shirley Institute were fully and freely placed at the disposal of the Corporation. The staff of our own Stations abroad sometimes showed themselves over-eager to take advantage of these facilities, and almost overwhelmed the Shirley Institute with the number of samples submitted for testing, so that the staff of the Spinning Test Department had to impose a limit. Nevertheless, when the ration was slightly exceeded, Sir Robert usually succeeded in having the whole number tested, to the great satisfaction of the plant breeders.

When the discussion of the organization of the Corporation's new Research Station in Uganda was in its earlier stages, Sir Robert's long experience of such problems made him a particularly valuable member of the Scientific Committee, and he was the originator of several helpful suggestions on many points ranging from the lay-out of buildings to the organization of the staff. Appreciating this, the Corporation persuaded him to remain a member of the Committee after he had relinquished his work at the Shirley Institute in 1943, and he only retired from it three years later. The Corporation owe much to the assistance he so liberally gave to their work throughout the twenty years over which his connection with it extended.

L. G. K.

ADVENTURES IN MECHANIZATION

BY

E. PHILLIS, PH.D., D.SC.,

Rubber Research Scheme, Ceylon

ONE of the absurd things about certain tropical countries is that imported potatoes are preferred to home-grown "ground provisions" such as yams and sweet potatoes. There are several reasons for this preference. One is undoubtedly connected with the relatively uniform high quality of the imported article, with its freedom from excessive waste. Another concerns the convenience of the unit size. But these advantages would not come into play so long as there was a reasonable price differential in favour of the local product. Potatoes grown with highly paid labour (by tropical standards) and carrying heavy packing and heavy land and sea transport costs can compete with the local product which faces no such heavy charges.

In the ultimate analysis, the problem resolves itself into the inefficiency of the native producer when measured in terms of output per man (or more often woman!) hour of work. Rice cultivation offers a glaring example of this same inefficiency. The highest yields in the world are obtained in Italy and Spain, in Australia and in the U.S.A., the lowest from the tropical countries.

There can be no doubt of the urgent need for improvement in social conditions of the masses throughout the tropics, and this can only come about in the long run through an increase in their own productivity. They must produce more and cheaper food for themselves so that they can be better fed, and at the same time they must raise more exportable produce, so that they may buy necessities which they themselves do not produce.

For some years the author was concerned with the improvement of local methods of food production and particularly with the mechanization of such practices. Trinidad is almost an ideal centre for such work, for the very progressive sugar cane industry has mechanized itself to a high degree, and there is a large amount of information on what can be and what has not so far been done with machines available. Above all, men who can handle modern agricultural equipment with skill are available.

Trinidad, like most tropical places, has a pronounced dry season when growth stops and growing crops ripen. This period lasts for the first third of the year and during it the soil bakes hard. The peasant with his limited equipment cannot cultivate these concrete-like soils, but the modern tractor can. The normal flat land clays require something between 20 and 25 h.p. to pull a single 14-in. bottom share plough. The peasant has to wait until the rains have so softened the land that he can work it with hoe or with his ox-plough. This means that about two months out of the precious eight months' growing season have gone before he plants his crop. During this period, the nitrate and other nutrient salts built up in the soil by biological action and by weathering during the dry spell are usually leached out and so the crop starts off on a depleted soil.

Another advantage of early cultivation is less obvious, but may be even more important. Many plants grown in the Tropics are markedly photoperiodic even though day length may vary by less than an hour during the year, and no matter what time they are planted they tend to come into flower with the shortening days. The standard rice varieties grown in Trinidad are highly photoperiodic and so late-planted rice heads in a much shorter period than early-planted rice of the same variety; this diminished growing period may reduce the possible crop to negligible amounts.

As the dry season ends and the rain begins the peasant requires to get rid of weeds and bush on his land and to break it up for cultivation again. If the weeds are left, they grow rapidly and have to be cut by hand and removed before the plough can be used. A much easier (and much less satisfactory) way is to burn off the bush at the end of the dry weather.

Such weed-covered land can be cultivated when dry with powerful equipment. The best equipment for this purpose, to the author's knowledge, consists of a heavy disc plough pulled by a track tractor. A Ransome Shugadisc plough pulled by a heavy International or Caterpillar track tractor can do excellent work under such conditions. Where the land is clean and free from a vegetative ground cover, share ploughs or chisels can be used with advantage, but these implements clog readily with trash. Smaller powered track tractors (40-50 h.p.) can do excellent work provided that their cultivation equipment is matched to the work in hand, and such tractors will most probably become the mainstay of contractors, doing cultivation work for small farmers on a contract basis, as in the cane farming industry in Trinidad.

There has been a tremendous development in England of small garden tractors of the 5-6 h.p. class. In my experience these machines have no place in tropical agriculture. They undoubtedly are very satisfactory under English conditions, where soils have been cultivated for centuries and where the physique of the driver and general atmospheric conditions are both in favour of these fairly heavy machines. But under tropical conditions with heavy soils, exhausting climatic conditions and drivers of substandard physique, I have not found them successful.

Still smaller and lighter machines (usually American) have proved very successful for general cultivation work once the land has been broken in by standard heavy equipment. They can do, for instance, an excellent job of weeding between rows of maize.

For general cultivation work on rough land I am entirely in favour of the track tractor as against the wheeled tractor. Wide treads with small grousers seem to be the more satisfactory combination for all-round use. There are occasions when the surface is dry enough and firm enough to enable the tractor to get a grip, but when a few inches below the surface is still soft enough to puddle. In such conditions, deep grousers cut through the crust and soon churn up the soft stuff below, so that the tractor is " bogged." Under such conditions wheel tractors are hopeless. Wheel tractors cost much less than track tractors of equivalent horse power and are generally more economical in performance when they can get ground grip. They are usually capable of much higher speeds than crawlers and on general grounds should be used rather than crawlers wherever possible.

There are conditions under which wheel tractors are much more suitable than track tractors—*e.g.*, for use on sandy soils where there is not the fear of " bogging down " and where the sand cuts steel tracks to pieces in no time. On the sandy coastal flats where coconuts are grown, wheel tractors have many advantages over track tractors.

To return to the first example—potatoes *versus* yams. What makes the cost of production of yams so high? The answer so far as one tropical colony is concerned (Trinidad, B.W.I.) is the very high labour costs involved.

Yam cultivation in Trinidad by the peasant normally involves the digging of trenches by hand, the filling of these trenches and banking over by hand, staking by hand, weeding and banking up by hand and finally digging the yam out by hand. Soil moving by hand is an expensive task; an acre foot of moist soil may weigh something like 1,500 tons. There is little wonder at the high price of yams when the hand labour involved is considered. But a good deal of the hand labour is unnecessary. A trench can be cut using a double mouldboard plough, or a ditching body. In light soils animal draught is adequate, but with heavier soils tractor power is essential. After compost has been put into the trench, the sides can be throw back to make a ridge either with the plough or with discs mounted on the tool bar of a tractor. When the crop is ready for harvesting, the yams can be lifted by a double mouldboard or a ditching body set to cut just below the bottom of the original trench. There is actually less damage by this process than there is in normal hand digging.

In the wet tropics one of the major considerations in all agricultural work is to have sufficient drainage to get storm water away as quickly as possible and to keep the base of standing crops above water level. For this purpose wide-based banks are often used, sometimes with a shallow V drain between the banks and at others with a deeper box drain. Mechanized equipment makes it possible to construct these banks quickly and economically. The ideal equipment is a large self-driven motor grader. To see beds being formed for, say, citrus cultivation with a grader of 120 h.p. is a revelation; even a much lighter grader towed by an independent tractor can do amazingly good work. Shallow V drains can be cut with ease, and the spoil moved up towards the crest of the bed. Where box drains are required, they can be cut with ditching bodies or with such specialized equipment as the Cuthbertson draining machine, and the spoil moved away from the drain up towards the crest of the bed by the grader blade. Such graders can also be used for weeding on cambered beds, where the crop (coconut or citrus) is planted along the centre of the bed, by lightly scraping the surface. Graders are not normally reckoned as agricultural equipment, but they can do excellent work, including keeping roads and traces clean and in good order. I have found them an extremely useful and versatile implement.

Suitable land can quickly be put into use for rice growing with mechanized equipment. The grader can be used for levelling. Drainage canals can be cut with ditching bodies, with the spoil heaped up on either side to form a rough bund. The opposite side of the bund can be dressed with the grader blade to form a wall of loose soil which consolidates with the early rains.

One piece of equipment has not hitherto been mentioned—the rotary hoe. I believe this form of cultivator has a big future before it, for it can incorporate vegetation into the top few inches of soil and leave the ground in excellent condition for plant growth. One very promising use for the rotary hoe is in paddy cultivation.

As the rains are due, the land is rotary hoed to cut down all weeds, etc., and incorporate them in the land. With the first rains, the weed seeds sprout. Then paddy is broadcast over the land and the area covered again with the rotary hoe, working at a very shallow depth. The weeds are uprooted, while the paddy is put into the soil, safe from birds. Further weed control can be exercised through control of the water level.

For tree crops such as citrus or coconuts planted on wide, shallow banks, the rotary hoe and the grader make an ideal pair of implements, preferably towed by a wheeled tractor.

Most mechanized equipment is heavy substantial stuff and so facilities have to be provided for handling it without undue difficulty. A winch on the power take-off of a big tractor is extremely useful for moving and for lifting heavy weights with a pulley lashed to a nearby tree. It is also desirable to have a truck capable of carrying heavy loads, fitted with a winch driven from the main shaft.

Heavy equipment can be hauled up an improvised ramp on to the platform, and be let down safely. "Bogged down" equipment can be pulled to safety. In fact, the uses of such a winch are innumerable and well repay the slight extra cost.

So far, no mention has been made of personnel. Rumour has it that the motto of African Groundnut Scheme operators is "Give us the job and we will finish the tools." I also have met operators of this type, but fortunately not in number. The best of machines requires careful maintenance and skilful handling to give of its best. As previously remarked, Trinidad is an ideal centre because skilful drivers and good maintenance mechanics are available. Anyone starting from scratch and having to train drivers and mechanics has a full time and almost certainly an exasperating job. I was fortunate, and apart from one or two false starts had an excellent team. Even then accidents happened. I remember one occasion when we were proudly transporting a heavy tractor by road on a new fifteen-ton trailer. As the outfit ascended on to a rather narrow but strategic main road bridge, one pair of front wheels left the trailer. We discovered later that the studs holding the wheels together had never been properly tightened up, and that the slight play between the wheels had caused the studs to be cut so deeply that they broke. To make matters worse, all the trailer's toolkit, including the jack, had been left at the base for safety! Fortunately the agent had spares, and within a few hours the matter was righted and the convoy on its way again.

This incident illustrates a very important point. "Orphan" equipment for which no adequate stock of spares is kept is just a perpetual headache and should be avoided at all costs. Certain British equipment is very bad in this respect. It is a matter in which, in my humble opinion, exchange control officials do not show sufficient understanding in their insistence on "Buy British." Adequate and easily obtainable spares are an essential for all agricultural equipment. Replacement parts fabricated on the spot are usually much more expensive than maker's spares, and are usually of inferior quality.

It is a pity that something cannot be done to standardize as many parts of equipment as possible. English threads differ from American, bolt head sizes differ, and so two complete sets of stocks and dies and of spanners have to be kept. Even worse is certain proprietary equipment where threads are neither the one nor the other. This procedure may be good for spare parts trade, but is not calculated to obtain replacement orders.

Where only one or two machines are kept, it is not economical to maintain an effective repair depot. The penalty is that when breakdowns do occur, the implement may be out of commission for two or three weeks at a critical period. Where there are several machines, it is beyond doubt worthwhile to maintain repair facilities to keep equipment running. The most useful workshop equipment, apart from a range of high-quality hand tools, is that for welding—both oxyacetylene and arc. The former is exceedingly useful for general repair work, metal can be cut and holes made, or bracing flanges can be welded on to weak spots. Arc welding is invaluable for hard facing cutting parts such as the leading edges of chisels, and for building up worn rollers and suchlike parts. Screw-cutting equipment is very useful, and while a good deal can be done with hand-operated stocks and dies, much more can be done with a lathe.

So far I have avoided any discussion on the economics of mechanized agriculture. The light machines used for weeding, etc., are very economical provided that they are supplemented by hand labour in difficult situations—*i.e.*, between the plants in a row. As equipment becomes heavier and more expensive so the economical aspect becomes more and more dependent on full and continued use. There is no point in spending seven hours a day moving a heavy tractor from field to field, with only an hour's actual ploughing. Given full usage, with a full range of implements, mechanical agriculture can be very successful and makes possible techniques which cannot be handled by any other means.

Most, one might say all, mechanized equipment is beyond the reach of the average peasant. Nor is the average holding suitable for mechanization, particularly in those areas where land is divided on inheritance. Much propaganda will be required before such small areas can be combined to form fields of a size suitable for mechanization.

I believe, however, once the peasant is shown and realizes the great value of mechanization, that he will take the necessary steps to bring about its widespread use. Just as " transport contractors " are now almost universal, so I think that cultivation contractors will spring up. Small owner-driven units, kept in first-rate order by their owners, and putting in long continuous periods of work, are possibly the most economical way in which mechanization can develop. Trinidad's cane farming industry or British Guiana's rice industry may serve as pioneer examples of communal activities.

Received November, 1949.

FIELD KEY TO THE PRINCIPAL DISORDERS OF COTTON IN AFRICA

BY

E. O. PEARSON,

Empire Cotton Growing Corporation

This key was first drafted early in 1947 as part of a projected handbook of African cotton pests. It will be some time before this book can appear, and several workers on cotton in Africa have suggested that the key should be published meanwhile, partly to help other such workers and partly in order to test and modify it by use. Criticism will be much appreciated.

The first key of this nature was that of Monsieur A. Brixhe, published in 1938 and applying particularly to the Belgian Congo. This served as a model for the one presented here, which was, however, designed for use anywhere in Africa. Recently a new edition of M. Brixhe's work has been produced,* much expanded and admirably illustrated, by which users of the key which follows are recommended, if in doubt, to check their conclusions.

Abbreviations:

Bact.	Bacteria
Col.	Coleoptera (Beetles)
Hem.	Hemiptera (Bugs)
Isop.	Isoptera (White Ants)
Lep.	Lepidoptera (Moths)
Orth.	Orthoptera (Grasshoppers, etc.)

I. SEEDLINGS

(*a*) Seedlings wither and collapse

1. Stem blackened from slightly above ground level down to root, large patches often affected—Sore-shin, *Rhizoctonia solani* (Fungus).
2. Root gnawed at or below ground level; shiny black many-legged millipede found amongst buried seed remains—Millipedes (Myriapoda).

(*b*) Seedlings clipped off

1. Stems clipped through just above ground level, but leaves not much eaten; pale brown termites approaching 1 cm. in length, moving in exposed columns on ground surface—Harvester termites, *Hodotermes mossambicus* (Isop.).
2. Holes chewed in stems and leaves or seedlings completely eaten
   - (i) Hopping insects, often gregarious—Locusts, grasshoppers, crickets (Orth.).
   - (ii) Caterpillars, often feeding at night and gregarious—Cutworms: *Agrotis ypsilon*, *Euxoa* spp., *Laphygma exigua*, *Prodenia litura*, etc. (Noctuidae, Lep.).

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* A. Brixhe.—Les Parasites du Cotonnier en Afrique Centrale: Tableaux de Détermination. Deuxième Edition. Bruxelles: Compagnie Cotonnière Congolaise. 1949.

II. WHOLE PLANTS

(*a*) Plants wilting

1. Leaves wilt suddenly and dry up from the edge inwards between the main veins; easily detached. Vessels show as brown dots at leaf scar and as brown streaks on breaking main stem. Roots unaffected externally. Usually sporadic, but susceptible varieties may be affected in patches—Wilt, *Fusarium vasinfectum* or *Verticillium dahliae* (Fungi).
2. Leaves wilt slowly. Upper part of main stem and woody core of root not affected, but minute black pustules may occur just below bark on surface of wood, bark becoming spongy and wet from root tip to slightly above ground level, easily rubbed off, leaving yellowish-grey stain and with characteristic smell. Usually in patches—*Rhizoctonia* spp. (Fungi).
3. Leaves wilt slowly, upper part of stem not affected, woody parts of root channelled; usually sporadic
   - (i) Large numbers of small "white ants" round roots, often constructing earthen runs covering basal part of stem—Termites (Isop.).
   - (ii) Single or small numbers of small white grubs decorticating root—Cotton beetle, *Syagrus* spp. (Eumolpidae, Col.).

(*b*) Patches of plants with leaves and soft part of stem and branches eaten

1. Irregular pieces excised from leaves; small faecal pellets (1-2 mm.) on ground —Locusts, grasshoppers (Tettigoniidae, Acridiidae, Orth.).
2. Whole plants or branches pruned, spoor recognizable—Goats, antelopes, elephant.

(*c*) Whole fields showing irregular tears in leaves and pale brown corky scars confined to one side of branches and main stem—Hail damage.

(*d*) Leaves and fruiting branches progressively dwarfed and flower buds shed; roots normal; occurrence sporadic

1. Main veins of leaves clogged, but no crinkling or mosaic (*cf.* IV. b. 8); occurs in West Africa—"Bunchy top," thought to be a virus.[*]
2. Affected leaves and upper surface of branches reddened, finally much secondary development of small abortive foliage. Only known from Belgian Congo. Causative insect rarely seen after symptoms develop: adult 2 mm. long, yellowish body, transparent wings decorated with brown spots on margin; immature forms resemble those of jassid, but sluggish—"Psyllose," caused by *Paurocephala gossypii* (Psyllidae, Hem.).

III. STEMS AND BRANCHES

(*a*) Upper portion of plant wilts, lower part remains healthy

1. Tip of main stem becomes flaccid and collapses. Large, black or brown, strong-smelling bug sucking main stem near tip—*Anoplocnemis curvipes* (Coreidae, Hem.).
2. Girdle of frayed fibres round main stem above which plant wilted or collapsed, almost legless grub channelling in pith
   - (i) Girdle near base of stem, grub slightly curved, adult a weevil—Cotton stem girdler, *Alcidodes* spp. (Curculionidae, Col.).
   - (ii) Girdle near apex of stem, adult with long antennae—*Tragiscoschema* spp. (Lamiidae, Col.).
3. Stem hollowed out, yellowish-white club-shaped grub about 2·5 cm. long present in tunnel, or conspicuous exit hole—Stem borer, *Sphenoptera* spp. (Buprestidae, Col.).

(*b*) Stems and branches brittle, small circular holes near nodes, which are often swollen; very small white grubs inside, small black weevils common on the plant —Stem weevil, *Apion* spp. (Curculionidae, Col.).

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[*] Hutchinson, J. B., Knight, R. L., and Pearson, E. O., "The Response of Cotton to Leaf Curl Disease," *J. Gen.* (in press.)

(*c*) Lesions on main stem and branches

1. Dark glassy-green lesions on petioles, pedicels, branches and main stem (often descending the plant in that order), becoming black and sunken; branches withered and blackened at tip, breaking or shedding—Blackarm, *Xanthomonas malvacearum* (Bact.).
2. Dark green sunken lesions, splitting longitudinally and turning brown owing to formation of corky callus; growth distorted and dwarfed, leaves bunched, dark green, crinkled. Insect agent not always seen; red or yellow-bodied fragile bug about 1 cm. long, with spine on back of thorax—*Helopeltis* spp. (Capsidae, Hem.).

(*d*) Stems covered in colonies of small, sedentary, white or pinkish wax-secreting insects, usually confined to unhealthy plants—Scale insects (Coccidae, Hem.).

IV. LEAVES

(*a*) General shape and colour of leaf normal

1. Holes in leaves
   - (i) Holes relatively large, irregular, with sharp edges—Leaf-eating caterpillars (many species), *Syagrus* spp. (small black beetles), locusts and grasshoppers.
   - (ii) Small, circular holes in either surface of leaf, often not carried right through, very small jumping beetles common—Flea beetle, *Podagrica* spp. (Halticidae, Col.).
2. Narrow, serpentine channels in green tissue below transparent cuticle on upper surface of leaf—Leaf miner, *Acrocercops bifasciata* (Tineidae, Lep.).
3. Spots on leaves
   - (i) Small brown spots
     - (*a*) Circular spots, with dark red margin and greyish centre, sometimes developing into holes—Leaf spot, *Cercospora gossypina* (Fungus).
     - (*b*) Minute angular spots with orange pustules in centre, on lower surface only—Rust, *Phakopsora desmium* [*Kuehneola gossypii*] (Fungus).
   - (ii) Larger, irregularly rounded, brown spots showing concentric zonation, tending to coalesce and cause leaf fall—*Alternaria* spp. (Fungus).
   - (iii) Angular spots, bounded by small veins, at first semi-transparent, later covered in white down—Powdery mildew, *Ramularia areola* (Fungus).
   - (iv) Angular spots, bounded by smaller veins, at first dark green, water-soaked, then dark brown to black. Spots frequently coalesce forming large areas which become tattered. Elongate lesions similarly formed along main veins, often running down petiole and causing leaf shed—Angular leaf spot, *Xanthomonas malvacearum* (Bact.).

(*b*) General shape or colour of leaf abnormal

1. Irregular holes in leaf, edge rolled into cylinder secured by webbing and containing pale green, semi-translucent, black-headed caterpillar—Leaf roller, *Sylepta derogata* (Pyralidae, Lep.).
2. Lower surface a dull, smoky green; edges of lobes curled under giving pointed appearance; later, small straight cracks all over leaf, which in extreme cases becomes tattered. Numerous exceedingly minute transparent glistening mites on under surface—"Acariose," caused by *Hemitarsonemus latus* (Acari).
3. Small angular light brown spots, not coalescing, close to main veins; lamina dark green, crumpled; in extreme cases leaves bunched together and distorted, with scorched appearance—*Helopeltis* spp. (Capsidae, Hem.).
4. Minute holes on very young leaves which, as the latter unfold, develop into larger irregular holes with healed, rounded edges to them; in extreme cases leaves completely fretted, venation irregular and size much reduced—*Lygus* spp. (Capsidae, Hem.).
5. Edges of leaves turning pale green, then yellow and finally red in successive zones more or less bounded by the transverse veins, rolling under and finally withering. Numbers of small, active, leaf-hopper adults, or immature forms

characterized by rapid crab-like movement on lower leaf surface—Jassid, *Empoasca* spp. (Jassidae, Hem.).

6. Leaf shape normal, colour mottled, initially yellow, then bright red, but a narrow strip on either side of the veins remaining bright green—" Feuille rouge " (physiological leaf reddening).
7. Leaves puckering, rolling under at edges, stunted; under surface with numerous soft-bodied sedentary green or black plant lice; leaf surface sticky, shiny, often covered by black sooty mould—*Aphis gossypii* (Aphidae, Hem.).
8. Leaf veins swollen and appear clogged when viewed against light, sometimes with foliar outgrowths. Leaves becoming crinkled, leathery and curling up at edges. Bracteoles similarly affected. In extreme cases stems whip-like and spiralling, all foliar parts much reduced. Sometimes associated with fine mosaic pattern of dark and light green on leaves. Symptoms only commonly developed on *Gossypium barbadense—i.e.*, Egyptian, Ishan and West African " Native " cotton. Clouds of minute white flies when plant disturbed; young forms on lower surface of leaf, scale-like, sedentary; associated with sticky secretion covering leaves and tips of stems—Leaf curl virus, transmitted by white-fly, *Bemisia* spp. (Aleurodidae, Hem.).
9. Lamina normal shape, sometimes reduced in size, surface silvery, eventually pale yellow, with papery texture and numerous minute black droplets on surface. Numbers of very small elongate insects—Thrips (Thysanoptera).

V. FLOWER BUDS

(*a*) Flower bud shed when very small, before reaching the size of the subtending stipule, with leaf damage as in IV. b. 4. In severe cases fruiting branches truncated, plant very tall and straggly with much secondary branching. Small green or brown bugs haunting terminal buds, shy, quick fliers—*Lygus* spp. and *Megacoelum* spp. (Capsidae, Hem.).

(*b*) Flower bud larger when shed, no hole in it

1. Dark glassy-green area, turning black, at base of calyx or on pedicel, often with angular leaf spot on the bracteole or blackarm on the branches—*Xanthomonas malvacearum* (Bact.).
2. Lesion as in III. c. 2 on pedicel, with associated symptoms—*Helopeltis* spp. (Capsidae, Hem.).
3. Minute black punctures on the unopened corolla, usually marked by a small drop or smear of yellow fluid. Medium small, delicate, opalescent bug, sheltering below bracteoles—*Creontiades* spp. (Capsidae, Hem.).

(*c*) Flower bud larger when shed with circular hole upwards of 1 mm. diameter in base, bracteoles often flaring back—Bollworm (see VII. c. 2 for key to species).

(*d*) Flower bud shed, bracteoles not flared, no visible causes—Physiological shedding, which may be due to a heavy crop of bolls already carried, drought, water-logging, or indirect results of jassid or aphid attack.

VI. FLOWERS

(*a*) Petals eaten by large, boldly marked red or yellow and black beetle—*Coryna* spp., *Mylabris* spp. (Meloidae, Col.).

(*b*) Stamens eaten, frequently whole staminal column gone and hole into the apex of the ovary—Bollworm (pink bollworm often found in this position, see VII. b. 3).

VII. GREEN BOLLS

(*a*) Boll shed, or aborted when very small

1. No hole in boll wall
    - (i) Dark glassy-green area at base of calyx, or below calyx at base of boll, turning black; boll contents stained olive green to brown, especially at base—Bacterial boll rot, *Xanthomonas malvacearum* (Bact.).

(ii) Lesion as in III. c. 2 on pedicel, with associated symptoms—*Helopeltis* spp. (Capsidae, Hem.).

(iii) Minute punctures through boll wall, visible externally as black dots or very small angular sunken areas—*Megacoelum* spp., *Creontiades* spp. (Capsidae, Hem.).

(iv) No punctures visible externally, but showing as small dots on inner surface of boll wall often surrounded by small water-soaked area or small button of spongy, white, proliferated tissue. Boll contents may be reduced to spongy, slimy, greyish mass—Stainers (Hem.), either Pentatomidae or more often *Dysdercus* (Pyrrhocoridae). If accompanied by yellowish-green staining, fungi of internal boll disease also present (see VII. b. 2).

(v) No visible causes—Physiological shedding (see V. d.).

2. Hole in boll wall—American, red or spiny bollworm (see VII. c. 2).

(*b*) Boll not shed, no hole in wall

1. Lesions on boll surface

(i) Irregularly rounded, dark glassy-green areas, up to 1 cm. diameter, sometimes slightly raised, subsequently sunken and turning dark brown from centre outwards, distributed generally over surface or, more usually, at extreme base of boll. Olive-green or brown staining and rotting of boll contents below lesion, often affecting extreme base of loculus and passing up central axis of boll—Bacterial boll disease, *Xanthomonas malvacearum* (Bact.).

(ii) Irregularly rounded, sunken, blackened areas, with reddish-purplish margin and salmon-pink powdery appearance developing in the centre; lint below stained pink; often secondary—Anthracnose, *Colletotrichum gossypii* (Fungus).

(iii) Circular spots up to 3 mm. diameter distributed over apical part of boll not protected by the bracteoles; at first dark green but not glassy, later forming shallow brown craters through which, in young bolls, a slimy, pallid or corky proliferated tissue is extruded. Lesions restricted to boll wall and do not pass through it—*Helopeltis* spp. (Capsidae, Hem.).

2. Boll wall superficially healthy, but on cutting open showing symptoms on inner surface as in VII. a. 1. iv. above. Embryo of seed often killed and replaced by floury tissue representing proliferated inner seed coat, lint sodden and matted, sometimes reduced to papery membrane.

(i) No staining, injury caused by feeding of uninfected sucking bugs, adults of which approximately 1·5 cm. long

(*a*) Pale green, shield-shaped adults, not usually very numerous—*Nezara* spp. (Pentatomidae, Hem.).

(*β*) Iridescent green, blue and bronze patterned adults resembling beetles, sometimes numerous—*Calidea* spp. (Pentatomidae, Hem.).

(*γ*) Somewhat elongate, flattened adults, yellow or red with black markings, frequently paired; young forms bright red, feeding gregariously in open bolls—Cotton stainers, *Dysdercus* spp. (Pyrrhocoridae, Hem.).

(ii) Lint stained pale yellowish or greenish-yellow—Stigmatomycosis or internal boll disease (*Nematospora* spp., Fungi) transmitted by sucking bugs as above.

3. Bolls superficially healthy, but on cutting open caterpillar found channelling amongst seeds, not exceeding 2 cm. length, pearly white when small but later stages with two transverse pink bands on each segment, the anterior one being the broader—Pink bollworm, *Platyedra gossypiella* (Tineidae, Lep.).

(*c*) Boll not shed, hole present

1. Hole small, neatly rounded, boll contents only partially eaten, no caterpillar present, the hole being the exit

(i) Irregular brown lines on inside of boll wall where larva has tunnelled before entering boll cavity; extensive rotting and destruction—False codling moth, *Argyroploce leucotreta* (Tortricidae, Lep.).

(ii) Clean, well-defined tunnels in boll contents, whole seed contents eaten out leaving seed coat—Pink bollworm, *Platyedra gossypiella* (Tineidae, Lep.).

2. Hole small, larva present inside boll
   - (i) Hole closed by thin membrane consisting of boll-wall cuticle; larva within as in VII. b. 3 above—Pink bollworm, *Platyedra gossypiella* (Tineidae, Lep.).
   - (ii) Larva not exceeding 2 cm. length, at first smoky grey with slightly darker spots, later uniform reddish pink colour, wriggling backward actively when head is touched—False codling moth, *Argyroploce leucotreta* (Tortricidae, Lep.).
   - (iii) Larva not exceeding 2·5 cm. length, thick set, brownish markings and numerous fleshy protuberances—Spiny bollworm, *Earias biplaga*, or Egyptian bollworm, *Earias insulana* (Noctuidae, Lep.).
   - (iv) Larva may attain 3 cm. length, pale duck-egg green ground colour with reddish trident-shaped markings on each segment—Red or Sudan bollworm, *Diparopsis castanea* (Noctuidae, Lep.).
   - (v) Larva large, perhaps exceeding 4 cm. length, pale straw coloured or green, with longitudinal brown stripes—American bollworm, *Heliothis armigera* (Noctuidae, Lep.).

3. Hole large, no caterpillar present
   - (i) Boll more or less full of masses of larval excrement—Spiny bollworm, *Earias* spp. or red bollworm *Diparopsis castanea* (Noctuidae, Lep.).
   - (ii) Boll contents cleanly eaten out, mass of usually pale straw coloured or greenish larval excrement *outside* the boll, between this and bracteoles—American bollworm, *Heliothis armigera* (Noctuidae, Lep.).

VIII. MATURE BOLLS

(*a*) Boll opening more or less normally

1. Small, black or dark brown, strongly smelling insects numerous amongst the boll contents, feeding on the seeds—Cotton seed bug, *Oxycarenus* spp. (Lygaeidae, Hem.).
2. Small insects coloured bright red or, when larger, red or yellow banded with white, feeding on seeds—Cotton stainers, *Dysdercus* spp. (Pyrrhocoridae, Hem.).
3. Pale yellowish stain on lint, general or patchy, locules sometimes partially aborted showing silvery patches of undeveloped lint. Puncture marks discernible on inner surface of boll wall—Stigmatomycosis or internal boll disease (*Nematospora* spp.) transmitted by stainer bugs.
4. Bright sulphur yellow, pink or reddish stain of lint, usually not associated with breakdown of boll contents or damage to the boll wall—*Epicoccum*, *Fusarium* or other fungi, or bacteria, entering after boll has split.

(*b*) Bolls not opening normally, carpels not fully reflexed

1. Hole in carpel wall—Bollworm.
2. Strands of lint webbing the partially reflexed carpels together; locules more or less aborted, stained greenish-yellow or in extreme cases lint reduced to brown papery membrane closely pressed to seeds, giving kidney-like appearance—Stigmatomycosis or internal boll disease (*Nematospora* spp.) transmitted by stainer bugs.
3. Similar to preceding but without webbing; damage usually starting from the extreme base of the loculus; colour usually darker, yellow to olive brown; associated with blackened external lesion at base of boll—Bacterial boll rot, *Xanthomonas malvacearum* (Bact.).
4. Boll wall covered in sooty powder, contents completely rotted; secondary —*Diplodia gossypina* (Fungus).
5. Small to medium sized caterpillar channelling in the more or less aborted tissues
   - (i) Larva feeding in seeds, often spinning cocoon amongst debris, appearance as in VII b. 3—Pink bollworm, *Platyedra gossypiella* (Tineidae, Lep.).
   - (ii) Small larva scavenging amongst debris, general pink or pinkish-purple colour which is more pronounced in the early stages than is the case in *Platyedra*—*Pyroderces* spp. (Tineidae, Lep.).

Received November, 1949.

MISSION TO CHINA

BY

R. A. SILOW, D.Sc.

PART I

When discussions first commenced in the summer of 1946 on the possibility of my going out to China to take charge of the scientific side of the activities of the British Council there, my wife and I found that we were faced with a difficult decision. In common with many other young people, we had been looking forward to an established home in England, and the opportunity once again of getting to know a pleasant countryside from which we had been away for so long—and it certainly did not appear to be a particularly ideal time to visit the Far East. Yet there were many factors that made us decide to avail ourselves of this totally unexpected opportunity to visit a country and a people in which we had long been interested, and in circumstances where one could perhaps make some practical contribution, however small, towards the strengthening of bonds of understanding and sympathy between the East and the West. We had enjoyed the friendship of many amongst the Chinese community in Trinidad, where we had lived for eleven years. On the more technical side, correspondence extending over many years and exchange of research material had led to the publication of a paper in the *Journal of Genetics* in joint authorship with a Chinese cotton worker in Nanking whom I had never met in the flesh, though we had heard a great deal about the vicissitudes which he and his colleagues had experienced up and down China during the war years, fortunately always one step at least ahead of the invading armies. Some of my colleagues with whom I discussed the matter told me quite bluntly that they thought it wrong that a scientist should leave his research work. On the other hand, I felt that there was room in the world—and tragic evidence of the need—for something other than the essentially self-interested trading and diplomatic relationships which have hitherto often been practically the only channels through which nations and races have come to know one another. This need has been recognized by some of the more far-sighted statesmen of this and other countries, and their efforts have led to the establishment of such diverse organizations as the various national cultural relations services on the one hand, of which the British Council is our own particular version, and the United Nations on the other hand, with its specialized agencies like WHO, FAO, UNESCO, and so on—organizations each with their own particular interests and purposes, but with this in common, that they stress and seek to develop the co-operative rather than the competitive aspects of international relations. There are many who scoff at the idealism of these constructive contributions to world harmony, just as they scoffed at the League of Nations earlier. We may well ask what possible chance of success these brave new efforts may have, if many of those who are best equipped to serve in them decline to do so. It must be recognized that such organizations exist, and that within them and many other official departments posts of administrative or organizational nature have been created which call for men with working experience in the sciences, technologies and the humanities. Unless some of those of us who are scientists are prepared to come out of the ivory towers in which our laboratories are, by popular tradition, reputed to be located, then those posts will necessarily go by default to men who have no knowledge or experience of science, and perhaps not much interest in it either. Recent developments have highlighted the need for a greater social awareness and responsibility on the part of scientists, and it is now up to them to recognize this need, and to take advantage of such few opportunities as exist where they can make their particular contribution to the urgent task of providing the background, both spiritual and material, for better international understanding. They can make their contribution not only as scientists in the technical sense, in making their special skills and knowledge available and in assisting to provide conditions which are conducive to the fullest utilization of current knowledge for the common good, but also in bringing to bear on the problems of interhuman relations the methods of reasoning and the intellectual standards which are the essential features of science.

Accordingly, the end of the year saw us making preparations for another upheaval in our way of living, and soon we were on our way, over the familiar waters of the Caribbean, through the Panama Canal, and across the Pacific. Approaching the Philippines from the east, over the most placid of blue waters, their surface broken only by myriads of flying fish and porpoises, it was difficult to believe that this was an area which had so recently seen so much strife. For nearly twenty-four hours before docking at Manila we sailed between the mountainous southern-lying islands, with their numberless cloud-capped volcanic mountain ridges; and even when entering Manila Bay, through the narrow passage between Corregidor Island and the Bataan Peninsula, there was remarkably little evidence of the terrific bombardment to which this area had been subjected. It was only in the last few minutes before docking, passing between the partially submerged and often overturned hulks of scores of vessels—naval and merchantmen, British, American and Japanese—that one received some preparation for the tremendous destruction to be seen on shore. Nearly opposite the docks was the blackened shell of the modern Manila Hotel, almost completely bombed and burned out at one time, but now about one-third rebuilt, and in that section functioning excellently. Driving about a mile to the modern commercial city, one passes first what was the old walled city of Intramuros. This was almost entirely obliterated, but the rubble has now been cleared and all that is left of what was once an intriguing old Spanish city is a most interesting ground plan of the narrow streets. Practically the only building still standing is the magnificent old St. Augustine Church, dating from 1599, bearing mute witness, amidst the surrounding desolation, to the solidity of its structure. It contains an interesting painting of Manuel Blanco, author of the Flora of the Philippines, who was a member of the Augustinian order. But it is a building of sad memories, for here almost all of the men of the old city were imprisoned, and later killed.

Further along the road towards the new city are the remains of many large modern government buildings, in the impressive Classical style so much favoured by the American people for the architecture of their public buildings. What a scene of desolation! Huge pillars of masonry stand knock-kneed and twisted; the fronts of once-white buildings are cracked, tottering, and blackened, floors and roofs conspicuously absent. The same general air of desolation covers the campus of the University of the Philippines, in the south-western suburb of San Andres, for it was one of the scenes of fighting for the liberation of the islands. Its buildings also were in the Classical style, and being the only solid ones in an almost entirely wooden city, were strongly fortified by the Japanese and used as centres of resistance. After taking the full weight of American shelling and bombing, these buildings were deliberately fired by the enemy as they retreated. The contents were saturated with petrol, and even densely packed books, usually difficult to burn, were completely destroyed—the library burned for seven days. In the Archæological Museum, glass meteorites or tektites, which melt at 1,250° C., were fused by the intense heat. None of the fifteen or twenty imposing stone and concrete buildings escaped very serious damage, and there is certainly no exaggeration in the local estimate of 90-95 per cent. loss in laboratory and office structures, and in scientific equipment, books, data and manuscripts. One of the greatest cultural losses suffered was in the complete destruction of the Bureau of Science, with the best scientific reference library in the Far East, including China and Japan. Nowhere else in my later travels in the Far East did I see so comprehensive destruction of what had originally been such solid buildings, and nowhere else was I so conscious of the appallingly low supply of good printed matter. It is true that in some of the islands, such as Borneo and New Guinea, whole townships had been obliterated, but they had been almost entirely wooden; and in China I saw cultivated fields where college compounds had been but a decade before: but here in Manila the destruction which we saw represented the material attributes of almost the entire cultural life of a small nation.

Notwithstanding the tremendous destruction, there was evidence of most determined rehabilitation of some of the less dangerous parts of some of the buildings, pending removal of the University to a new 1,500 acre site at Diliman, Quezon City, ten miles to the north-west—but this will probably take all of five or ten years to accomplish. In some few cases the ground-floor was usable after filling in bomb-craters. Practically no interior walls were left standing, and classes proceed behind temporary but by no means soundproof screens of plaited split bamboo, whilst windows have been replaced by salvaged rusty galvanized-iron flaps, riddled with bullet and shrapnel holes. A considerable amount of teaching is also done in the buildings of the nearby Philippine General Hospital, which itself suffered much damage but less complete destruction than most other buildings. In one tiny corner, the only relatively safe portion of the first floor of the former library building, I found that the much-esteemed President of the University, Dr. Bienvenido M. Gonzales, had established himself—together with the one functioning telephone on the campus. He, like by far the majority of presidents of universities in the Far East, is a scientist—a most significant pointer to interest in that part of the world. Of some 960 degrees awarded by this University in 1946, covering the entire period since the previous pre-occupation awards, 404 were doctorates in medicine, dentistry, or veterinary science; 9 were masterates; and of the remaining 547 bachelor degrees, only 128 were non-scientific. Everywhere in the Far East I was to find this overwhelming preponderance of interest in science in higher education. After training in the United States in animal husbandry and genetics, Dr. Gonzales was associated for twenty-nine years before the war with the College of Agriculture, some 30 miles south at Los Baños, for a long period as Director. Here particular attention has been devoted to the breeding of cattle, pigs and poultry, with emphasis on the factors underlying adaptation to tropical conditions. The Philippine approach to the problem in cattle was largely by way of hæmoglobin estimation and its correlation with temperature control, in contrast to the Japanese approach by way of sweat-gland count. Particular success was achieved in the development of the "Philamerind" from the Native Yellow cattle (probably Chinese in origin), Texas Hereford and South Indian breeds. It was a dual-purpose animal in the sense of work and meat, with short legs and good working body derived from its local parent, weight and grazing capacity from its American parent, and high resistance to rinderpest and tolerance of heat and poor pasturage from its South Indian blood. Unfortunately the foundation stock is now much reduced, and it will be necessary to repeat this and much other similar work in pigs and poultry.

With only 5 per cent. of its former material resources available, the University has of necessity adopted a policy of restriction, limiting student enrolment at present to about 4,000, or one half the pre-war figure. Strenuous efforts are being made to maintain educational standards in the face of great difficulties, including that of recruitment and retention of staff, many of the best of whom are being drawn off, necessarily, by the requirements of the new diplomatic and other government services. Although the educational institutions of such countries naturally look somewhat askance at this drain on their intellectual resources, it seems to me that both they and international relations in general stand eventually to gain, for some of the most outstanding personalities are now to be seen amongst the representatives of those countries which have but recently graduated into the international sphere, and have had to call on the faculties of their universities for their diplomatic personnel. In the Far East in particular such men are most highly regarded.

In the Philippine Republic many other institutions also go by the name of university. The historic Roman Catholic University of Santo Tomas, founded in 1611, twenty-five years earlier than Harvard, the oldest in the United States, and authorized to grant degrees since 1624, has some 5,000 students, and is of very good collegiate standing in some of its departments. Other establishments, some with as many as 7,000 students, are obviously commercialized institutions of technical training rather than higher education, and their relative standards are reflected in their financial organization. Student fees, of the order of £30-£50 per annum, are surprisingly comparable in all universities in the country, but whilst in the National University the cost to the State for training each student is nearly five times the tuition fee, one of the large private universities is said to make 20 per cent. on its student income, whilst others made several times their capital outlay in a year! The existence of this type of commercialism in education, on such a scale, appears deplorable to those of us who live in more fortunate circumstances, but the demand for higher education is there, as it is throughout the Far East, and until the authorities are able to provide better it is no doubt good that learning should be available to the population even in such a way. In any case, standards there cannot and should not be expected to be the same as in the West, with its centuries of more liberal social background.

I found the Bureau of Plant Industry Experiment Station located in the middle of what was before the war an exclusive residential area, but now all trace of former residences as well as Experiment Station buildings is gone. With a much depleted staff, rehabilitation is under way. It was here that I first heard of the custom of interplanting cacao and coconuts—two crops which, to those of us who have lived in the West

Indies, appear rather incompatible in their requirements. I heard of this in connection with a search for a cacao strain resistant to *Phytophthora faberi,* the pod-rot fungus, which also causes bud-rot of coconut—though whether the same race of the fungus is involved on the two hosts is, I believe, a moot point. I came across this custom again in New Britain and New Guinea, on volcanic ash soil which presumably supplies the major common requirement of these crops, which is good drainage. The cacao can be established at any time after the coconuts are about 3 feet high. Maintenance costs are low, for the coconuts require practically no attention, and their yield is if anything increased, whilst the cacao needs only desuckering, and provides a leaf mulch beneficial to both crops. Such mixed cultivations were in remarkably good condition after the war, whilst the years of neglect of ordinary cacao plantations had led to their death. Other shade trees such as *Erythrina* have been tried, but in these islands coconuts have been found much better.

During my short stay in Manila I met many of her outstanding leaders in the scientific and educational fields, and their Anglo-Saxon orientation of outlook was particularly noticeable. In a population of 18 million, some 5 million speak English. Mr. Fernando Amorsolo, Head of the Fine Art Department of the National University, most kindly showed us some of his historical paintings based on the writings of Pigafetta, the historian who accompanied Magellan in his voyage of 1521. They depict an unexpectedly high standard of life for some at least of the natives of that time, with gold ornaments and vases of Chinese ceramic ware much in evidence. Now social conditions are very different. The population has practically doubled in the last thirty years, and present conditions provide a fertile soil for the political unrest which is sweeping across the eastern countries. With the already established ties with the West, the importance of the Philippine people as an interpretative link between the Anglo-Saxon and the oriental countries should not be neglected. There is already much cultural contact with the United States, but there is room for much more interchange with Britain. Very few Philippine students have continued their studies in British Universities; one outstanding example is provided by the former Professor of Law in the National University, who is now in Washington as Philippine Ambassador; I heard of two others in the College of Pharmacy, and one of them whom I met had been in the Department of Physiology at Cambridge in the late 20's, and was now investigating basal temperature in the human subject, especially in relation to time of ovulation under tropical conditions. With the keen interest in Britain and British things which is in evidence in the Philippines, it is to be hoped that more of her students will have an opportunity to come to this country.

At the 1939 meeting of the Pacific Science Congress in San Francisco it was decided that the Philippines should be the venue of the next meeting scheduled for 1943. Events determined otherwise, but at the postponed Seventh Congress held recently in New Zealand, the Philippine delegation again most generously put forward an invitation from their Government that the eighth meeting should be held in their country. This is but one indication of the determination with which educational and scientific reconstruction is proceeding. Although the tasks ahead of this new republic are no easy ones, what I saw and experienced convinces me that, when the time for the next Pacific Science Congress arrives, in some four or five years' time, there will be little shortage of material and spiritual hospitality. Scientists in all fields will find much of fascinating interest; just by way of example, I saw or heard of research in subjects as diverse as plant taxonomy, algology, pharmaceutical chemistry, industrial chemistry, mineralogy, veterinary medicine, malariology, nutrition, leprosy, ethnology and archæology. The establishment in 1935 of a National Research Council had a most salutary effect on scientific work in the country, and the holding of an international congress will give stimulus and encouragement to men who are working on the fringe of the scientific world—encouragement which is so much needed after the set-back of the war years. It must be remembered that whilst the war provided an impetus to much scientific development in the West, it had exactly the opposite effect in such a country as the Philippines.

Probably the features which most strike the new arrival in the East are its bustle, excitement and colour. Shanghai, which could, I think, rightly claim to be the most congested city in the world, has all of these. Pedestrians jostle one another on the narrow sidewalks—pedestrians arrayed in silken or cotton gowns of an infinite variety of shades of blue and grey, admirable background to the bronze faces and shiny black hair of the Chinese people. Here and there is a splash of red imparted by the clothes of the younger children, their little shoes and bonnets often most fascinatingly trimmed with white fur in the design of a bunny's head and ears—the rabbit being a symbol of good luck. Almost as soon as we arrived we were whisked off to the airport for Peking—literally whisked off, for the driver of our car careered along at a pace incredible in the circumstances, first to the right and then to the left of trams which were so densely packed that passengers bulged out of the doors and windows. In and out we went amongst hundreds of pedicabs and rickshaws between which there was obviously no possibility even for a cat to crawl. Straight for a solid phalanx of these flimsy vehicles the car would head, a terrible accident inevitable—yet miraculously, at the very last second, a path cleared and we squeezed through and on, horn never silent. The quiet dignity of the placid passengers in those rickshaws, as they so unconcernedly and impassively raised a hand to our car as if the very act were sufficient to halt it in its tracks, was a demonstration of faith which never failed to call forth our admiration, for it was something that we could never hope to emulate. We swerved to avoid superstitious peasants from the country who ran directly and immediately in front of our car, to cut off the devil that was supposedly close behind them. We trailed lorries piled high with bales of cotton from which ragged beggars running behind were tugging handfuls of loose fluff. This they stuff into their thin cotton garments as a protection against the savage winds of winter. High on the bales of cotton perched a porter with a long leather thong which he slashed from time to time at these pitiful beggars, many of them mere children. From the general inaccuracy of his aim it was not difficult to surmise where his sypmathies lay, and the loss from wharf to factory must often have been as high as 10 or 20 per cent. At cross-roads the rickshaw pullers were the worst traffic offenders, especially in their efforts to beat the traffic-lights. Punishment was meted out on the spot—perhaps a cushion impounded for a couple of hours, and so the rickshaw immobilized and a fare lost, or a more fortunate offender might merely receive a swipe across the face and be allowed to continue on his way. Such summary punishment, although contrary to all our principles, is perhaps the only way of dealing with offenders who, as likely as not, have no permanent address and are probably completely illiterate. It certainly kept the traffic moving, and the Chinese traffic police on the whole did an extraordinarily good job, retaining their humour under conditions which would sorely tax the patience of a constable trained in a more orderly metropolis.

Soon, from the serenity and comfort of a Skymaster, we were engrossed in the scene spread beneath us. The brick-red waters of the Whangpoo and the Yangtze, surrounded by a patchwork of canals and tiny bright green fields, gave place to the arid mountains of Shantung. Our arrival in Peking was preluded by a breath-taking glimpse of glistening lakes, pagodas, and the yellow-tiled roof tops of the Imperial Palaces and the Forbidden City. As if all that were not enough for one day, as soon as we got inside our hotel bedroom, tired and satiated with new sights, we rang the bell, intending to order tea—and in walked three curio-dealers who soon had the floor and beds covered with what looked to us like all the treasures of the East—silks, embroideries, pearls, cloissonné, jade, porcelain, filigree, lacquer-work, painted scrolls—and promises of much else if Master or Missie would but say the word.

One of our first duties on arrival in such cities, all over China, was to pay a courtesy call on the Mayor, and on the Provincial Governor if he also was located in the vicinity. I trust that I shall not be offending anyone by saying that in China the mayor is a more important personage than is his counterpart in the West—he is, after all, nominee of the President. There followed visits to the Department of Education, and to such other municipal and government departments as concerned science in any of its manifestations, and then to the various educational and research institutes. The purpose of my tours around China was to make contact with China's scientists and technologists at all levels, with a view to facilitating the inward flow of knowledge and information concerning scientific affairs in Britain. It was also my responsibility to make arrangements for visits to Britain by those of China's scientists who could contribute to a closer understanding and collaboration between our respective nations in the cultural field—postgraduate students, lecturers, professors, research workers, educational and research institution administrators, government officers, and so on—some of them as guests of the British Council, many others independently.

We spent nearly three months in Peking—longer than I had anticipated would be necessary, but far too short a period for all that I would have liked to do there. Peking has been regarded through the ages as the leading cultural centre of China, and many so still regard it, although a very effective and successful challenge has been put up, over the past three decades, by a large number of progressive institutions further south, especially in the Yangtze valley. Knowing the importance of Peking, I was nevertheless hardly prepared to find as many as seven universities there, with a further two in the nearby city of Tientsin, many of them with their full complement of Colleges of Arts, Education, Commerce, Science, Medicine, Agriculture and Engineering—and each of these with a multiplicity of departments. We visited virtually all of those on the scientific side—both pure and applied in all its aspects—seeing something of laboratory and library facilities, discussing work and problems with professors and lecturers, and individually with many of the students as well, and sometimes lecturing or delivering an address. The leading universities in Peking are right in the forefront of the field of higher education in China, and fully equivalent in scholarship, even if not always in facilities, to the best of those in the West, such as Oxford, Cambridge, London, Yale or Harvard. At the other extreme a few of the colleges, especially in certain of their departments, were at about the high school standard.

There was, in addition, a large number of institutions of other types to visit—the National Academy of Peiping with its various Research Institutes of Botany, Zoology, Chemistry, Physics, Materia Medica, and Archæology; the National Library; the Fan Memorial Institute of Biology; the Meteorological Observatory; the Geological Survey; the Peking Union Medical College; the National Vaccine and Serum Institute (located in the grounds of the Temple of Heaven, with its tiles of true heavenly blue, and a white marble Altar of Heaven, acres in extent and open to the stars—what finer site has a research institute anywhere in the world?); the National Institute of Health; the National School of Midwifery; the Municipal Tuberculosis Clinic; the Municipal Child Health and Welfare Clinic; the National Agricultural Research Bureau; the National Animal Husbandry Research Bureau; the Municipal Agricultural Experiment Station; the Cotton Improvement Bureau; the National Industrial Research Bureau and various factories; and the World Science Association. Small wonder that, with so much ground to cover, the weeks sped by. Only one Sunday—and that turned out to be a rainy one—was it possible to assign to the Forbidden City and its limitless treasures; and apart from a single evening, as we made our way to more important attractions, we had only hurried glimpses of the fascinating one-handicraft and one-commodity streets of bazaars—Lantern Street, Fan Street, Silk Street, Embroidery Street, Jade Street, and so on.

The list of scientific interests in Peking alone, which I have given above, is important as an indication of the remarkable ramifications of the present-day organization of science in China. In all of these institutions important work is going on—some of it leading to research contributions, in various languages, to many of the principal scientific journals of the world, other parts of it of more localized significance. Practically all of this development has occurred since the overthrow of the Manchu dynasty in 1911, the greater part even much more recently, since the establishment of the centralized authority of the present Nationalist Government in about 1927-28. When it is remembered that since that time a great part of the activity of the Central government has been directed against either Communism or Japanese aggression, and that in the north there were only about three years of confidence and relative stability before the tide turned, then what has been accomplished takes on an added significance. No matter what the future political regime of China may be, the people themselves are even more determined than ever that modern science and technology shall expand to the utmost—and they mean business.

Almost every visit without exception which we made to these institutions was associated with one of the feasts for which China is so justly famous. In some cases these were on the more formal side, with only the President or Director and his departmental heads present; in other cases the group would include twenty or thirty professors as well; but often it would be an informal get-together with nearly all of the staff, perhaps nearer a hundred in number. I cannot speak too highly of the warmth with which I was everywhere received as a representative of Britain, and of the overwhelming hospitality and kindness which was shown us. Although my mission was essentially non-political, there was intense interest in our parliamentary system and our social services, which are so much admired and envied by the less fortunate Chinese people—so that meals were interspersed with discussion of parliamentary procedure, educational programmes, social welfare schemes, and the like—with perhaps an embryologist on my left, a physiologist on my right, a surgeon, a mathematician, a geologist and a physical chemist across the table, all awaiting their opportunity in their own particular speciality, often so very different from mine. With questions of all kinds coming from all directions, I was more than thankful for the presence of my wife to share them. How difficult under such circumstances to do justice to the maybe twenty-two courses, and with chopsticks in our inexperienced hands at that—such famous delicacies as shark-fin soup, deer's tendons, octopus, squid, bean-sprouts, bamboo shoots, delicious Peking duck, diced pork so tender and spiced, to name but a few; sweet dishes like silver-ear fungus, almond junket, or eight-precious-fruit pudding, coming never at the end of the meal but about two-thirds way through the savoury dishes, to be followed as likely as not by a large fish grilled entire over a charcoal brazier, the final course always rice. Small wonder that the inevitable has been hastened, and that of late our visits to the tailor have been unduly frequent—another inch required around the waist! Small wonder also that one's physical system often rebelled at such over-generous plenitude of rich and unfamiliar fare, and, sad to say, this was frequently a source of serious embarrassment in a programme which demanded all of one's physical and mental resources.

One such reception which we recall particularly was in the home of the then Mayor of Peking and his charming French wife. Sitting afterwards in the beautiful moonlit garden, on a warm July evening heavy with the fragrance of oleander, conversation ranged far and wide, vieing with the huge frogs croaking on their lotus-leaf thrones in the lily-ponds around us. The lotus, blossoming afresh each year in beauty and dazzling purity as it rises from the lake-bottom mud, has come to be accepted as a national emblem, token of the New China that will similarly arise from her present travail. Travail indeed it is. This particular evening was one of the few when we did not hear nearby gunfire beyond the city walls; indeed the tranquillity led to comment that it was exactly ten years previously, to the very day, that Peking had been occupied by the Japanese armies, and many of those present and talking to us had been leaders of those gallant bands that had decided to withdraw into the interior, there to continue resistance against the aggressor.

Almost every one of the institutions in Peking, as in other later-occupied cities, had partaken in this trek. Some of them went directly westward into the north-western provinces, but most went south and south-west to Chungking, Chengtu and Kunming and surrounding areas in the extreme west and south-west, where they were joined by others from Nanking and the southerly coastal provinces. This involved a journey of up to 2,000 miles or more, by land or river, over mountainous and difficult terrain, through areas of intensive military activity and blockade, and often under gunfire or bombing. Nevertheless, in spite of danger, confusion and distress, the major universities and research institutes succeeded in transferring at least a part of their equipment and books to places of safety. Professors, research workers and students carried their apparatus, books and a few of their personal belongings by junk, ox-cart or on foot, and eventually set up their classrooms and laboratories in old temples, caves or hastily erected wooden buildings. Some institutions moved only a short distance, into what they thought to be safety, but as the enemy advanced they found it necessary to move further and further into the interior. Many moved in this way two or three times, one as many as seven times, before they found a haven that lasted until the end of the war. There China's leaders in the academic and scientific field struggled to perpetuate their traditions of culture and scholarship, amidst appallingly disheartening conditions and often with but little of their original equipment and few books still remaining to them. It was particularly to break down their intellectual isolation, and to bring them news of the continued progress of literature, science and technology in the West, that British Council activities first commenced in China, in the autumn of 1942, in the form of a cultural goodwill mission. This led to the establishment of the Sino-British Science Co-operation Office in Chungking, under the direction of my predecessor, Dr. Joseph Needham. Through this office a great deal of scientific and technological co-operation was channelled, in the form of donations of books and periodicals, exchange of data and scientific samples and specimens, assistance with publication in Western journals, award of postgraduate studentships, issue of official invitations to Britain, and so on, and this has continued right up to the present time. This collaboration, and practical demonstration of sympathy, is needed, and appreciated, now as much as ever it was during the war. With the continuing inflation, economic conditions have steadily deteriorated. Leading professors, directors of institutes, and departmental heads, who before the war enjoyed reasonably adequate standards, are mostly now living in only one or two small rooms with a wife and perhaps several children; until shortly before the recent arrival of Communist troops they were receiving salaries equivalent to only £6 or £10 per month, and that had to be spent within a few hours before its value dwindled to one-half or less. Meals often comprised only a bowl of rice a day, with a little meat once a week, far less than our present ration. How the Chinese people long for something approaching our equality. China has great wealth, but far greater and more all-pervading poverty, and this contrast is evident everywhere. In the rich city of Shanghai, where almost anything in the world could be bought—at a price—beggars livid with small pox have pushed their hands at me; I have seen living corpses, eaten with leprosy, lying in the gutters; I have seen the terrible toll that is taken by that rampant scourge, tuberculosis, which thrives under existent social and economic conditions; I have seen beggars awaiting the arrival of the scavenging carts at the municipal rubbish-dumps, eager to scratch over the indescribable refuse. All this notwithstanding the fact that the ordinary Chinese peasant or coolie is probably as energetic and conscientious a worker as can be found in any country. Small wonder that so many of the Chinese people are prepared to welcome any change, in the belief that conditions could not be worse and may be better.

Such aspects of China can be terribly depressing, for one can seldom get away from them for more than a few minutes at a time. Yet there is also so much of charm, beauty, culture and dignity that we look forward to an opportunity to revisit this hospitable country.

To be concluded in April issue.

THE EXPERIMENTAL EVIDENCE FOR MICHURINIAN GENETICS

BY

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In the English-speaking world it is the custom to conduct scientific controversy with dignity and with scrupulous moderation, and it is a pity that some English-speaking scientists overlook this custom when they criticize the peculiar branch of genetics now very popular in the Soviet Union. There is, of course, ample provocation for severe criticism. The fact that Mendelian geneticists are now persecuted in Russia raises the genetics controversy far above the level of mere scientific dispute: it undermines the very foundations of international science. This grave situation has so filled the minds of some British and American biologists that they are unable to regard so-called Michurinism as objectively as (for example) their predecessors regarded Mendelism some five decades ago. So the enquirer who asks precisely what is the experimental evidence for Michurinian genetics is as likely as not to receive an impassioned sermon on freedom of science.

There seems to be a serious risk that the narrowly scientific aspects of the Soviet genetics controversy, since they seem to be so unimportant ~~to some~~ British scientists, will be forgotten altogether. Lysenko considers Mendelism to be unproved and not worth proving: this circumstance alone weakens our confidence in Lysenko's positive views, but it does not prove that his views are incorrect. The purpose of this article is to summarize briefly the experimental evidence, such as it is, on which Michurinian genetics rests.

The evidence begins with the work of Michurin himself. As long ago as 1905 Michurin published articles in which he criticized the low level of fruit production in his part of Russia. At that time the only procedure for improving fruit trees was to introduce varieties from foreign countries. Michurin challenged this procedure, and claimed that the only way to acclimatize new varieties was to grow them in Russia from seed. Clearly seedlings raised from a horticultural variety are likely to differ from one another genetically, so when Michurin began to put his precepts into practice he found himself with thousands of seedlings, and he had to select stringently among them. It is evident that Michurin " had a good eye " for plants, because he succeeded in selecting strains of apples and pears and cherries which satisfied the commercial grower. His next step was to hybridize unlike varieties, and again to select suitable strains from these hybridizations, and some of these selections, too, were commercially successful.

Michurin's records of these accomplishments resemble the popular articles by practical men in a garden magazine. He was innocent of any scientific training, so he was in confident possession of all the gardener's prejudices—that plants can be permanently altered by climate, that seedlings are more impressionable than older plants, and so on. And, since he had for years selected among highly heterozygous material, Michurin regarded the process of inheritance as something pliable and always elusive: a spell of drought would tend to make a hybrid resemble its mother, a cold snap would predispose the hybrid to resemble its father, and so on. The acclimatization of a plant was, for Michurin, like the education of a child: with art and care anything could be made of it. Hard climate and poor soil were not obstacles to horticulture: they were conditions to be observed in plant selection. Michurin adopted fifty years ago a defiant attitude to Nature which nowadays would be labelled good Marxism. At the same time he brought about great improvements in Russian fruit culture, which must formerly have been very primitive indeed.

It is a simple development of this attitude which led to the use of "mentors." The speed of Michurin's selection work was conditioned largely by the time taken for his seedling trees to flower. He grafted twigs of an old tree on to the lower parts of his seedlings and (in the absence of any controls) he formed the opinion that the scions accelerated flowering. The scions seemed to have other, more profound, effects, for once fruiting had begun, Michurin asserted that there were changes from year to year in the shape and quality of the fruit. He attributed these to the powerful effects of "old" scions on the young pliable seedlings: they had acted as a "mentor." In subsequent years other virtues were attributed to mentors. For instance, two potato varieties which would not hybridize could be made to do so if one were first grafted on the other, and then the flowers on the scion were hybridized with flowers from other individuals of the stock. This method of ensuring successful hybridization is still applied on a large scale at the potato breeding institute near Moscow.

Practices such as these brought Michurin into prominence as a plant "inventor." The very fact that his method involved the raising of large numbers of heterozygous seedlings confronted Michurin with an immense amount of natural variation. He was obliged to pick and choose among the variation, and he picked and chose with great skill. This skill, especially as it was exercised in a community with very primitive horticulture, was dramatically successful. Michurin's practical success tempted him (just as Burbank's success tempted him) to theorize about biology. It is evident from his writings that he never grasped the rudiments of plant physiology or genetics; but that did not prevent him from writing very frequently and very dogmatically. It is not surprising that Mendelism ("the notorious pea laws," as Michurin called them) shocked him. Their simplicity seemed so blatantly out of harmony with the complexities that Michurin had observed, and their implication, namely that "characters" were not moulded by the environment, challenged the very assumptions upon which Michurin had scored his triumphs. So again and again in his writings Michurin inveighs against Mendelism, and indeed against all scientific experimenters who fail to produce useful varieties of plants. His criterion was always: "What use can be got out of the work? What profitable varieties were produced because of the work?"

Michurin's confidence in his own work is easy to understand. In a country where plant selection had never been tried, Michurin succeeded in producing dozens of improved varieties of plants, especially fruit trees. He worked with very heterozygous strains. He was totally ignorant of the procedure of scientific experiment, and he imagined that the variations which he selected had been evoked by his own skill. He imagined, too, that the purpose of genetical research was to produce new varieties of horticultural and agricultural crops; and on this criterion he was evidently more successful than such men as Mendel, Bateson, Correns and Baur.

When Russia emerged from the October revolution, Michurin (now an old man) found, obviously to his surprise, that his rule-of-thumb principles coincided with the philosophy of the State. To parody Molière, he discovered he had been talking Marxism-Leninism all his life. He was honoured; towns were called after him; his work was lavishly supported. For here was a man who believed crops could be made to measure for any climate and soil, and who had for a quarter of a century spluttered his contempt for the sort of agriculturist who laboriously collects data, reads temperatures, makes sketches, and yet produces no new varieties: "a lot of talk, and little real work." So Michurin, whose early adventures in hybridization were criticized by his contemporaries on the ground that he was "turning God's garden into a brothel," found himself a hero because he believed, and had in some degree demonstrated, that plants can be trained to bear fruit in any and every environment.

If one reads Michurin's writings (some of which have recently been published in English) one is prepared for Lysenko, and indeed for the whole genetics controversy. For Lysenko is merely a twentieth-century Michurin, working on cereals instead of fruit, and equipped with a little more education and a much less modest disposition. And he finds himself in a philosophical atmosphere which precisely suits him. The task of increasing crop production in Russia is sacrosanct; yields must be increased immediately; there is no time for the cautious hypercritical experiments of scientists: so it was a foregone conclusion that if Lysenko "delivered the goods" he would be entrusted with the highest responsibilities in Soviet agriculture. Lysenko did "deliver the goods." He selected heterozygous wheats and millets in the way Michurin had selected pear trees, and he proposed a score of simple tricks to increase yields. He encouraged manuring of the land; he urged farmers in arid districts to keep weeds down through cultivation; he advised planting rows of millet at greater distances apart in poor soil. The surprise was not that Lysenko accomplished these elementary improvements, but rather that no one in Russia had accomplished them before. Lysenko's reputation was made, as Michurin's was made, because he brought common sense into a very primitive agriculture.

But Lysenko had to face much greater opposition than Michurin faced; for plant improvement in the Soviet Union had fallen into the hands of geneticists who would not hurry Nature and who wanted to consolidate every step in their work. And when Lysenko wrote dogmatic articles hardly distinguishable from those Michurin wrote three decades earlier, he found himself ridiculed by Soviet geneticists. He applied to them the test Michurin had applied to his adversaries: had they in fact increased yield of cereals by a single pood? The answer was "No." And had Lysenko? The answer was indubitably "Yes." But he did more than this; the modern way to confuse geneticists was to beat them at their own game. Lysenko knew enough botany to go through the motions of an experiment, and he and his colleagues published a number of experiments purporting to demonstrate the plasticity of the genotype (in a young plant only). It was nothing more than a repetition of some of the assertions Michurin had made: that both environment (especially exposure to cold) and grafting influence the genotype.

It is important to realize that for Lysenko himself these experiments are superfluous. The proof of his theories for himself and his colleagues is that he has improved crop yields. That is sufficient. It is to convince Mendelian geneticists that Lysenko has carried out experiments, and his "key" experiment, the one he still refers to when defending his views against critics, is one published in *Yarovizatsia* (January-February number, 1941) under the names Avakyan and Yastreb. This paper concerns grafts made between three varieties of tomatoes: "Meksiki" No. 353 (a small red-fruited variety), "Albino" (a large white-fruited variety), and "Preserving" (a red-fruited variety). It is asserted (on the basis of F_2 generations containing from 6 to 50 plants) that the genotypes of the stocks "leaked into " the scions and that seeds from fruits borne on the scions did show blending inheritance following graft hybridization. No precautions were taken to ascertain whether the parents were homozygous or not. Trusses were not bagged to prevent cross-fertilization (which, although rare in tomatoes, cannot be considered impossible). And only *abnormal* fruits were selected to provide seed for the F_2 generations. Subsequent work done in Russia on these same varieties demonstrated that they were not homozygous. The paper illustrates several examples of variation in F_2 which the authors attribute to the effects of graft hybridization. One does not need to question whether these variations actually were obtained. It is probable they were; there is no reason to believe the data are fraudulent: but they can all be explained quite simply as examples of segregation, possibly combined with some virus infection.

Similar results have been reported for potatoes: in these instances the scion affected the properties of the tubers, which thereafter were permanently changed. Some of the tubers used were periclinal chimeras, and since the " education " of these tubers involved cutting out the " eyes " and promoting adventitious buds from deeper seated tissue, it is not surprising that permanent changes occurred. In brief, the experimental evidence for modern Michurinism rests on the effects of natural segregation, and possibly also natural selection, in highly heterozygous lines of plants, without controls and without the most elementary precautions of the scientific worker. What is usually overlooked by the British or American critic is that this experimental evidence is not considered important by Lysenko or his followers. They do not need such evidence any more than a devout Christian needs proof of the existence of God. It is a gesture to the scientists, no more. The evidence which matters to Lysenko is on the collective farms and in the granaries. It is this remarkable confusion of two entirely separate activities—the art of farming and the science of genetics—which has made the genetics controversy so bewildering to western people.

The leaders of science in Russia have no more faith in Lysenko's views on genetics than they have in astrology. But they recognize that Lysenko has a genius for agricultural administration and that the present agricultural emergency is no occasion for long-term research: so they tolerate his views on genetics just as H.M. Government might tolerate the views on fairies held by a Chancellor of the Exchequer, provided he were a successful Chancellor.

Received November, 1949.

PROSPECTS FOR WORLD RAW COTTON PRODUCTION AND CONSUMPTION IN 1949-50—A PRELIMINARY SURVEY

BY

DUDLEY WINDEL

According to the latest statistical data, world stocks of commercial raw cotton at the beginning of the present season totalled approximately 14,809,000 bales—an increase of approximately 979,000 bales compared with a year previous. Last season world production exceeded consumption for the first time since the termination of the war.

SUPPLY AND DISTRIBUTION OF ALL COMMERCIAL COTTON IN THE WORLD*

American in Running Bales; Other Growths in Equivalent 478 lb.
Net Bales (000's omitted)

Season	*Carryover August 1*	*Production*	*Total Supply*	*Consumption*	*Destroyed*	*Carryover July 31*
1936-37 ..	13,649	30,729	44,378	30,638	45	13,695
1937-38 ..	13,695	36,745	50,440	27,573	165	22,702
1938-39 ..	22,702	27,509	50,211	28,507	66	21,638
1939-40 ..	21,638	27,326	48,964	28,496	206	20,262
1940-41 ..	20,262	28,720	48,982	26,595	220	22,167
1941-42 ..	22,167	25,616	47,783	25,033	165	22,585
1942-43 ..	22,585	25,582	48,167	24,293	304	23,570
1943-44 ..	23,570	24,521	48,091	22,566	121	25,404
1944-45 ..	25,404	23,631	49,035	22,204	233	26,598
1945-46 ..	26,598	19,890	46,488	23,110	337	23,041
1946-47 ..	23,041	20,279	43,320	25,893	205	17,222
1947-48 ..	17,546	23,489	41,035	26,975	230	13,830
1948-49 ..	13,830	27,222	41,052	26,043	200	14,809
1949-50 ..	14,809	30,110	44,919			

World production, which has tended steadily upwards since hostilities ceased, promises to register a further increase during the present season. A tentative survey of prospects in the various producing countries indicates a world commercial crop of 30,110,000 bales, or 2,888,000 bales more than last season.

No very important increase is anticipated in the harvest in the United States, but much better yields look probable in Mexico, India, Russia, Pakistan and Brazil, partially offset by decreases in Egypt and

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* Source: New York Cotton Exchange to 1946-47. Writer's estimates 1947-48, 1948-49 and 1949-50.

East Africa. Estimates for the Southern Hemisphere crops are naturally highly conjectural at this early stage, as they have only recently been planted, but prospects for the Northern Hemisphere are now fairly clearly defined.

WORLD CARRYOVER AND PRODUCTION OF COMMERCIAL COTTON IN THE WORLD

AMERICAN IN RUNNING BALES; FOREIGN IN EQUIVALENT 478 LB. NET BALES (000's OMITTED)

World Stocks, July 31, 1949		*World Production*, 1949-50	
U.S.A.	5,300	U.S.A.	15,800
Canada	50	Mexico	820
Mexico	215	Other N. America	45
Other N. America	20		
Brazil	875	Brazil	1,700
Argentina	400	Argentina	450
Peru	175	Peru	300
Other S. America	120	Other S. America	100
U.K.	1,584	Europe	205
France	400		
Italy	320	Russia	2,700
Russia	750	Turkey	365
Germany (all Zones)	150	Persia	100
Holland	70	India	2,500
Belgium	90	Pakistan	950
Sweden	60	China	1,000
Spain	100	Burma	30
Czechoslovakia	70	Other Asia	145
Poland	120		
Other Continent	150	Egypt	1,700
		Belgian Congo	230
		British East Africa	350
India	850	Nigeria	50
Pakistan	40	French Africa	140
China	700	Portuguese Africa	130
Japan	335	Sudan	250
Turkey	90	Other Africa	20
Other Asia	140		
		Elsewhere	30
Egypt	900		
Belgian Congo	85		
Other Africa	300		
Australia, etc.	50		
Afloat	300		
	14,809		29,110

It will be noticed that of the total indicated world supply for the present season of 44,919,000 bales, U.S.A. cotton accounts for 20,500,000 bales. Moreover, on July 31 last, the U.S.A. was the only producing country with a sizeable exportable surplus.

Prospects for the harvests in the various cotton-growing countries during the present season are tentatively summarized below:

NORTH AMERICA

United States.—Acreage planted to cotton last spring at 27,359,000 acres was almost 20 per cent. larger than the 1948 area of 22,768,000 acres. The growing season was very favourable in Texas, California, Arizona and New Mexico, but excessive rains and too cool temperatures adversely affected the crop in the Central and Eastern States by considerably increasing weevil damage. The average yield per acre as indicated by the December Bureau was 285·8 lb., compared with the record of 313·1 lb. attained last season, pointing to a total harvest of 16,034,000 bales (500 lb.), or approximately 15,200,000 running bales.

Mexico.—The 1949 planted acreage is estimated at around 1,350,000 acres, or about 300,000 acres more than the 1948 figure. The crop enjoyed a favourable growing season, and a record production of around 820,000 bales is in prospect.

SOUTH AMERICA

Brazil.—A slightly larger area is believed to have been sown to cotton in the Northern States last spring than a year previous. Good weather conditions prevailed, resulting in a high-grade crop estimated at around 102,000 metric tons, which compares with a 1948-49 outturn of 92,500 metric tons.

The quantity of cotton seed distributed to farmers in the Southern States last autumn is reported to have been 35 per cent. larger than in the 1948-49 season. Drought delayed planting, but good rains came in time to ensure satisfactory germination, and current prospects are very promising. If the growing season continues favourable, it is anticipated that the harvest will reach 280,000 metric tons, or 60,000 tons more than the past crop.

Peru.—The 1949-50 cotton acreage is believed to be about 5 per cent. larger than the 1948-49 area. Under normal weather conditions, a crop of around 300,000 bales (478 lb. net) should be realized, against 265,000 bales harvested last season.

Argentina.—The high prices obtained from the past crop have stimulated increased plantings in all the cotton-growing zones, and the crop has made a very promising start. A harvest of around 450,000 bales is tentatively predicted, or 50,000 bales more than the disappointing 1948-49 outturn.

AFRICA

Egypt.—Acreage under cotton this season is estimated at 1,689,498 feddans, an increase of around 17 per cent. on the 1948-49 area of 1,440,809. The growing season was generally satisfactory in Upper Egypt, but too cool weather in the Delta resulted in heavy leaf worm damage. The second official estimate of the total crop was only

8,047,000 cantars, or rather 700,000 cantars less than last season's production.

Sudan.—Acreage planted to Sakel-type cotton last autumn is believed to be little changed from the 1948 figure, but some increase is reported of the planting of American-seed types in the rain-grown districts. Total production is expected to approximate to last season's outturn of 1,239,070 cantars.

British East Africa.—Planting of the 1949 crop in Uganda was delayed about a month by drought, but good rains fortunately relieved the situation in time, and the area sown was slightly larger than last year. The 1948-49 season, however, was unusually favourable, and it is thought unlikely that the harvest will reach the 400,000 bales (400 lb.) then attained.

The 1949 Tanganyika crop experienced mixed weather conditions, and the outturn is not expected to equal the 1948 yield of 50,000 bales (400 lb.).

French Equatorial Africa.—The 1949-50 commercial crop is provisionally estimated at around 26,000 metric tons.

Nigeria.—High prices offered to native growers stimulated an increased demand for seed at planting time, and the exportable surplus will probably exceed 55,000 bales (400 lb.).

Belgian Congo.—Drought has somewhat marred prospects for the 1949-50 cotton crop, and it is thought doubtful if the harvest will reach 48,000 metric tons.

Portuguese Colonial Africa.—The 1949-50 Angola-Mozambique crop is tentatively estimated at 130,000 bales (478 lb. net)—a small increase on the outturn for the previous season.

EUROPE

Continent.—Aggregate production this season is expected to exceed 200,000 bales—or about 55,000 bales more than in 1948-49. Larger crops are indicated in Greece, Yugoslavia and possibly Spain.

ASIA

Russia.—No reliable information is available regarding the 1949-50 cotton harvest, but unofficial reports state that climatic conditions were much more favourable than last season.

Turkey.—Acreage planted this year is understood to be around 20 per cent. larger than the 1948 figure, indicating a production of around 365,000 bales (478 lb. net)—an increase of approximately 50,000 bales.

India.—A larger area was sown to cotton than last season, though no official estimate is yet available. The crop has enjoyed an unusually favourable monsoon, and the commercial yield is likely to reach 3,000,000 bales (400 lb.) or 600,000 bales more than last season.

Pakistan.—Acreage under cotton is reported to be about the same as that in the previous season. The growing season has been favourable except in parts of Sind, and a crop of around 1,100,000 bales (400 lb.) is generally anticipated, or about 150,000 bales more than the 1948-49 harvest.

China.—Owing to the civil war, information regarding the 1949-50 cotton crop is very fragmentary. Estimates of the total outturn range from 1,850,000 bales (478 lb. net) to 2,000,000 bales, but these can hardly be considered reliable. The quantity that will be available for commercial consumption is also highly problematical.

WORLD CONSUMPTION OF RAW COTTON

On the basis of data so far received from the various cotton-consuming countries, prospects for world consumption this season are little changed on balance from the total of 26,043,000 bales estimated for the 1948-49 season. Small increases in the United States, the U.K., Japan and a number of continental countries will probably be offset by small reduction in Canada, India, Brazil and elsewhere.

CONSUMPTION OF COMMERCIAL COTTON IN THE WORLD

AMERICAN IN RUNNING BALES; FOREIGN IN EQUIVALENT 478 LB. NET BALES (000'S OMITTED)

	1948-49	1949-50
U.S.A.	7,800	8,000
Canada	383	360
Mexico	250	230
Other N. America	70	65
United Kingdom	2,015	2,100
France	1,050	1,000
Russia	2,100	2,500
Germany (all Zones)	850	900
Italy	900	825
Belgium	375	370
Czechoslovakia	275	280
Holland	250	260
Poland	380	400
Spain	350	300
Switzerland	130	120
Portugal	160	150
Sweden	125	125
Hungary	130	145
Austria	85	105
Other Europe	320	300
India	3,500	3,300
Pakistan	100	120
Japan	700	750
China	1,400	1,000
Turkey	175	200
Other Asia	350	350
Brazil	800	750
Argentina	400	425
Peru	60	70
Other South America	210	200
Africa, Australia, etc.	350	300
	26,043	26,000

Cotton mill activity in the *United States* declined sharply last spring and summer due to accumulating stocks in wholesale and retail distributive channels. By the autumn, however, this situation had been largely corrected, and a marked improvement in domestic textile demand influenced most mills to increase their rate of operations. Nevertheless, it is anticipated that keen competition will develop during the coming months from imported textiles produced in countries which have devalued their currencies, as well as from the domestic rayon industry, and the full season's consumption of raw cotton is therefore not expected to more than slightly exceed last season's figure. Prospects for the *Canadian* cotton industry are viewed less favourably for the same reasons. *Mexican* cotton mills are experiencing difficulties in selling their production, due partly to their obsolete machinery and partly to the low level of internal purchasing power.

No important change in the aggregate is indicated this season in raw cotton consumption in the *South American Republics.*

In the *United Kingdom* shortage of labour still precludes any important expansion in textile production, but cotton consumption promises to be slightly larger than last season. On the *Continent* raw cotton importation difficulties in many countries are stimulating increased use of synthetic fibres on both sides of the " Iron Curtain," and it is doubtful if aggregate consumption of the natural fibre will be any greater than during the 1948-49 season.

The situation as regards *Asia* is rather obscure. No reliable information can be obtained from *Russia* owing to the rigorous censorship on all economic news, but the reported larger domestic cotton crop should enable the Russian mills to increase their consumption to some extent. The position of the *Chinese* cotton mills is even more confused following the Communist occupation; however, it can be presumed that more domestically grown cotton will be available for commercial consumption than last season, when Shanghai was virtually dependent upon imported foreign cotton supplies. Consumption of raw cotton by the *Indian* mills this season will probably be curtailed to some extent by the limited supply of domestic cottons owing to lack of foreign exchange and the political rift with Pakistan. Progress in the rehabilitation of the *Japanese* cotton industry is also likely to be impeded by raw cotton importation problems; at present, the United States is providing Japan with about 700,000 bales of raw cotton annually, the greater part in the form of an outright gift, but additional supplies can be obtained from other countries only on a barter basis, and such deals cannot easily be arranged. In an effort to overcome this raw material scarcity, Japan is endeavouring to accelerate her output of rayon.

World Rayon Production

Before the last war raw cotton was a cheaper raw material than rayon, but since 1939 cotton prices have risen by about 300 per cent., while rayon prices have advanced by less than 30 per cent. In consequence substitution of rayon for cotton is now proceeding at an accelerated pace in almost all parts of the world.

World rayon production in 1949 will be substantially higher than in 1948, and a further increase is in prospect in 1950. There is a large potential capacity in both Germany and Japan yet to be brought into production, and in many other countries new rayon plants will shortly be ready to come into operation.

In addition to rayon, cotton is now meeting with keen competition from the more economical paper in the bagging industry.

Conclusion

The world price of raw cotton is being kept artificially high for two basic reasons: (i) the high support prices established by the Government of the United States; and (ii) the comparative scarcity of cottons grown outside the United States.

The world-wide acute shortage of dollars makes it impossible for foreign countries to purchase more than a modicum of American cotton with their own hard currency resources. The European and Japanese-aid programmes will enable the United States to distribute up to 4,000,000 bales of American cotton this season, but this quantity will not be sufficient materially to ease the pressure of demand for other cottons which can be bought either for sterling or on bilateral barter terms. Consequently it would appear probable that non-dollar cottons will continue to sell abnormally dear relative to dollar cottons for some time, especially as the European-aid programme is progressively to contract and is due to terminate in 1952.

The longer term correction of this disequilibrium will be attained only if (i) the United States so modifies its fiscal policy—*i.e.*, through increased imports and overseas investment—as to provide the world with dollars to buy adequate quantities of American raw cotton and other primary products, or (ii) the rest of the world so expands its cotton and rayon production as to become largely independent of dollar cotton. On present indications no important progress looks probable in the former direction, and it is significant that the United States is aiming to prevent any further accumulation of her cotton surplus by a 20 per cent. cut in the 1950 planted acreage. However, in the latter direction, there are already welcome signs that raw cotton production is expanding, and helped by the steadily growing output of rayon and other synthetic fibres, the world dependence on dollar cotton should progressively diminish over the coming decade.

Received December, 1949.

REVIEWS

LES PARASITES DU COTONNIER EN AFRIQUE CENTRALE: TABLEAUX DE DÉTERMINATION. A. Brixhe. (Deuxième Édition, 1949, Bruxelles: Compagnie Cotonnière Congolaise.) Monsieur Brixhe's pioneer effort to provide an illustrated key to the affections of the cotton plant in the Congo, which appeared in 1938, was the inspiration of a resolution by the Empire Cotton Growing Corporation to follow his example with reference to the pests and diseases of cotton in the British Empire. (This project was long delayed by the war, and more recently by difficulties of compilation, and has been narrowed in scope to the African dependencies; a preliminary field key by Mr. E. O. Pearson appears in this issue of the Review.) M. Brixhe and his publishers in the second edition of his work have set a standard which will be exceedingly difficult to approach. The copious illustrations which reproduce photographs and drawings in line and colour are near to perfection. The text of the tables of identification is compact and clear. An introduction discusses briefly the significance of the damage due to pests and diseases, the nature of the organisms concerned and, at somewhat greater length, the means of reducing their attack.

Although the book is designed for use in the Belgian Congo the affections described are mostly of general occurrence in the African tropics, and many of them beyond. The value of the illustrations, particularly, will extend over the wider field, since they involve no difficulties of language.

W. N.

SYLLOGE FUNGORUM CONGENSIUM: CATALOGUE DES CHAMPIGNONS SIGNALÉS AU CONGO BELGE ET AU RUANDA-URUNDI. F. L. Hendrickse. (Bruxelles, I.N.E.A.C. Série Scientifique No. 35. 1948. Prix 100 Fr.) Mycologists and pathologists working in tropical Africa will value this list of the fungi recorded from the Congo Belge and Ruanda-Urundi for purposes of comparison and reference. The comparative thoroughness with which the fungus flora of these regions has been studied is reflected in nearly 200 pages of records. The bibliography provides a useful key to previous publications dealing with the mycology and plant pathology of the regions concerned.

W. N.

NOTES ON CURRENT LITERATURE

COTTON IN INDIA AND IN PAKISTAN

1. Indian Union: Final Crop Forecast (All-India). (*Cotton*, M/c., 15/10/49.) The consolidated final estimates of cotton crop, 1948-49, of the Indian Union, issued by the Directorate of Economics and Statistics, New Delhi, is as follows. The total area of the crop amounted to 11,055,000 acres, and the total yield reached 1,864,000 bales. This shows an increase of 3·8 per cent. in area and a decrease of 14·8 per cent. in yield as compared with the figures for last year. Among the varieties grown Bengals accounted for 223,000 bales, Americans for 35,000 bales, Oomras for 533,000 bales, Broach for 63,000 bales, Surti for 54,000 bales and Dholleras for 124,000 bales. All these varieties showed a decline in yield as compared with last year.

2. Irrigation Projects for the Cotton-growing Areas of India and Pakistan. (*Mthly. Rev. Wld. Sitn.*, Int. Cott. Adv. Cttee., September, 1949.) In the subcontinent of India, there are prospects of increased cotton production through irrigation, although they are more imminent in Pakistan than in the Indian Union, where the implementation of plans is still being worked out and the necessity for food production is more pressing. In Pakistan nearly 80 per cent. of the cotton area is already irrigated. Additions to the irrigated area will result from new projects now under construction in West Punjab and contemplated in Sind. In the Indian Union only about 5 per cent. of the cotton area is irrigated. The Government has, however, very extensive plans for increased irrigation and, as they develop, at least marginal or indirect benefit should accrue to cotton. Two projects may be mentioned. The first involves the irrigation of 800,000 to 900,000 acres in the rice-producing area of West Bengal from the waters of the Damodar River. It is expected that the International Bank will make a loan in this connection shortly. The second is a much larger and more complex project involving the irrigation of some 3 million acres from the Sutlej River in the Bhakra region of East Punjab where cotton cultivation is widespread. Negotiations between the Indian Union and Pakistan are involved in this project.

3. Methods of Tests on Fibre, Yarn and Cloth at the Technological Laboratory, Matunga. By D. L. Sen. (*Tech. Bull. Ser. A.*, No. 69, 1948. Ind. Cent. Cott. Comm.) Tests on agricultural samples were first undertaken in the laboratory in 1924 and the testing of trade samples has been in progress since 1930. By December, 1948, more than 10,000 samples had been subjected to the spinning and fibre tests and, as a result, the testing methods and spinning technique employed at the laboratory have undergone a process of standardization. In view of the fact that the methods and technique remain substantially the same from year to year, it was decided to describe them in a bulletin, which was published in 1933. Since then, several important changes and additions have taken place in the testing methods and the technique employed at the laboratory, and it was thought expedient to revise and enlarge the former bulletin.

4. Technological Reports on Standard Indian Cottons, 1948. By D. L. Sen. (*Tech. Bull. Ser. A.*, No. 70. Ind. Cent. Cott. Comm., 1948.) This bulletin contains the detailed results of tests on standard cottons of the 1947-48 season, together with the results for the previous seasons. It also gives the agricultural details, the grader's valuation report and the spinning master's report on each cotton as well as complete information regarding the treatment, waste percentages, yarn breakages and physical conditions prevailing in the laboratory. For the season 1947-48 the results of all nine Pakistan cottons have been omitted from the bulletin. A new

cotton, Karunganni Co. 5, which is expected to cover an area of 1½ lakhs of acres, replacing K1, C7 and other mixed cottons, has been added to the list. In view of the almost complete replacement of 1027 A.L.F. by Suyog, the results of the latter variety will be included in this bulletin in place of the former from 1948-49 onwards.

A table is included which shows the production and the staple length of the Indian cotton crop according to trade descriptions, the blow-room loss sustained by each cotton and the type of yarns for which it is suitable.

5. TECHNOLOGICAL REPORTS ON TRADE VARIETIES OF INDIAN COTTONS, 1948. By D. L. Sen. (*Tech. Bull. Ser. A.*, No. 71, 1948. Ind. Cent. Cott. Comm.) This bulletin contains the results for their 1947-48 crop of 31 trade varieties. Each technological report gives the grader's valuation report, spinning master's report and the table of spinning test results, which shows the waste losses, number of yarn breakages in the ring frame, the actual counts spun, the results of the lea test and the ballistic test, actual number of turns per inch, from roller and spindle speeds, drafts employed, estimate of yarn neppiness and yarn evenness and the physical conditions of temperature and humidity prevailing in the spinning room and the yarn testing room. The results of fibre tests, however, are not included. Comparative results of tests on samples received during the previous eight seasons are given.

6. TECHNOLOGICAL INSTITUTE OF TEXTILES, BHIWANI. (*Ind. Text. J.*, **59**, **1949**, p. 697. From *Summ. Curr. Lit.*, xxxix, **19**, 1949, p. 375.) A brief history and description are given of the Technological Institute of Textiles, Bhiwani, its organization and equipment. Teaching began in 1943 and the buildings were completed in 1946. The spinning machinery is on the basis of 14,000 spindles and there are 300 looms.

7. INDIAN COTTON: PRICE CONTROL. (*Cott. and Genl. Econ. Rev.*, 4/11/49.) While discussing the raw cotton situation with members of the cotton trade in Bombay, the Cotton Director explained that merchants had nothing to fear unless they traded at prices above the maximum fixed for respective varieties. A defect in the cotton control, however, is that the Government has not fixed prices for seed cotton, and textile mills, rather than merchants, are at present indulging in the malpractice of buying seed cotton at up-country centres at prices which would work out above the maximum ceilings. The Textile Commissioner has powers to call for samples of full pressed bales of cotton from mills or merchants, to have them valued by the Ad-Hoc Committee and to freeze the cotton so valued if above ceiling price. He also said that the Government have plans ready for the zonal distribution of cotton, and should an emergency arise, they would put it into operation by distributing quotas of varieties of cotton to mills all over India.

8. INDIAN COTTON, EXPORT DUTY INCREASE. (*Cotton*, M/c., 26/11/49.) Advices from New Delhi dated November 19, 1949, state that the Government of India has raised, with effect from November 18, 1949, the export duty on raw cotton from Rs. 40 (£3 sterling) to Rs. 100 (£7 10s. sterling) per bale. The Ministry of Commerce announcement added that owing to internal shortages exports of cotton would be allowed to hard currency countries only.

9. INDIAN COTTON SPINNING AND WEAVING MILLS. (Millowners' Association, Bombay. *Indian Text. J.*, **59**, 1949, p. 550. From *J. Text. Inst.*, **40**, 8, **1949**, **p.** 355.) A list is given of 36 new mills in the course of erection in the Indian Dominion and also a statistical survey of cotton spinning and weaving mills actually working in the Indian Dominion and Pakistan on August 31, 1948.

10. INDIAN COTTON GOODS EXPORTS. By W. A. Foges. (*Indian Text. J.*, **59**, 1949, p. 494. From *J. Text. Inst.*, **40**, 8, 1949, p. A354.) The increased export of cotton goods from India is advocated and the suggestions are made: (i) that the Government should increase the total quota of cloth for export to 500 million yards for 1949, (ii) that the 10 per cent. export duty should be lifted, (iii) that India should export more goods to Indonesia, and (iv) that the export of genuine handloom goods should be pushed.

11. Cotton Waste: Chemical Pulping. By D. R. Dhingra and B. B. Mithel. (*Ind. Text. J.*, **59**, 1949, p. 688. From *Summ. Curr. Lit.*, xxix, **19**, 1949, p. 359.) The present utilization of cotton waste in India is reviewed and the availability of cellulose from cotton waste is discussed. Samples of cotton waste were freed from non-cellulosic material by mechanical cleaning, washing, and the action of chlorine, and analytical data on the cellulose contents of cotton wastes from various mill operations are tabulated. On the basis of these results and annual raw cotton consumption figures for Indian mills, it is calculated that about 15 per cent. of the total cotton is expelled as cotton waste and could yield over 350,000 bales of chemical pulp annually. Utilization of cotton wastes as raw materials for the pulp industry is strongly recommended.

12. Pakistan: Cotton Quotas. (*Cotton*, M/c., 3/9/49.) The Pakistan Government have announced their export policy for the coming season. India has been allocated 450,000 bales and European countries 105,000 bales, including 40,000 bales to the United Kingdom. It is understood that the European quotas are only interim figures as they are valid only up to February 28, 1950. A further 100,000 bales will be allocated to other countries not specially mentioned on the basis of their ability to supply Pakistan with required imports.

13. Pakistan: Central Cotton Committee. (*Weekly Pakistan News*, 15/9/49.) At the two-day meeting of the Pakistan Central Cotton Committee, ended on September 24, it was decided to request the Central Government to give a grant of Rs. 10 lakhs to the Pakistan Central Cotton Committee for capital expenditure, and to increase the cess from four to eight annas per bale of cotton to enable the Committee to meet current expenditure on research and extension schemes, and also to invite the International Cotton Advisory Committee to hold its 1951 session in Pakistan.

It was also decided to set up a Planning Committee which would advise in regard to the areas to be grown under different varieties of cotton and to establish a botanical collection of Pakistan cotton varieties. A decision was taken to finance schemes for production of long staple cotton and cultivation of Egyptian cotton in Sind and also the scheme for improvement of cotton in the Thal area, West Punjab. For the investigation of root rot of cotton in West Punjab, it was decided to request the Provincial Government to appoint a competent botanist for the work, which would be financed by the Pakistan Central Cotton Committee. The Committee agreed to undertake a survey of the cotton crop in Lyallpur district this year.

14. Pakistan: Crop Forecast, 1948-49. (*Fortnightly Cott. Rept.*, **2**, **24**, 1949, p. 7.) The fourth and final forecast of the area under cotton crop for the year 1948-49 is 2,715,000 acres as against 3,122,000 acres reported in the fourth and final forecast of the previous year and shows a decrease of 13 per cent. There was a general decrease in the acreage throughout Pakistan, which is attributed to unfavourable weather conditions. The area under American varieties decreased by 14 per cent. from 2,629,000 to 2,262,000 acres and that under Desi varieties by 8·1 per cent. from 493,000 acres to 453,000 acres.

The final forecast of the yield of this crop is 980,000 bales (400 lb.) as against 1,115,00 bales reported in the previous year's forecast and shows a fall of 12·1 per cent. Except in East Pakistan, there was a general decrease in the yield of this crop throughout Pakistan, which is attributed to unfavourable weather conditions. The out-turn under American varieties decreased by 12·9 per cent. from 949,000 bales to 827,000 bales and that under Desi varieties decreased by 7·8 per cent. from 166,000 bales to 153,000 bales. In certain parts of the West Punjab and Bahawalpur State the crop was damaged by frost. In addition the premature opening of bolls of American varieties also resulted in decreased out-turn. The condition of the crop was below normal.

15. Pakistan: Cotton Export Duty. (*Cotton*, M/c., 8/10/49.) Advices from Karachi, dated October 5, 1949, state that the Government of Pakistan has decided to reduce the export duty on short-staple cotton from Rs. 60 (£6 10s.) a bale to Rs. 40 (£4 6s. 8d.) a bale.

16. PAKISTAN: CREDIT FACILITIES FOR COTTON. (*Weekly Pakistan News*, 19/11/49.) The National Bank of Pakistan Ordinance, 1949, published in a Gazette Extraordinary on November 8, provides for the immediate establishment of a Government-sponsored Commercial Bank to be called the National Bank of Pakistan. The bank will in the beginning concentrate on the provision of credit facilities for jute and cotton, extending its activities to other types of banking business at a later date.

COTTON IN THE EMPIRE

17. COLONIAL EMPIRE: DEVELOPMENT OF RAW COTTON SUPPLY. The third annual meeting summoned by the Empire Cotton Growing Corporation to enable their Executive Committee, which comprises representatives of the main organizations in the trade, to discuss matters of mutual interest with their Scientific Advisory Committee and with representatives of the British Cotton Industry Research Association, the Cotton Board, the Raw Cotton Commission and scientific workers from overseas, was held at the Shirley Institute, Manchester, on September 21, 1949. The discussion was centred chiefly on the steps necessary to secure that Colonial cottons should meet the spinners' requirements, particularly as regards regularity. It was agreed that to achieve this object, steps must be taken by the Governments concerned to ensure adequate control from the issue of seed up to the marketing of the lint, and that incentives for the production of good quality cotton and satisfactory ginning be provided by means of price differentials.

18. SOME HISTORICAL NOTES ON THE CULTIVATION OF COTTON IN BRITISH GUIANA. By G. D. Stevenson. (*Trop. Agric.*, xxvi, 1-6, 1949, p. 67.) This article gives a brief history of the cultivation of cotton as a commercial crop in British Guiana. The first mention of export is in 1762, when the amount is given as 10 bales. By the end of the century cotton had developed into a major crop, but with the abolition of slavery, labour difficulties arose, and the area under the crop declined rapidly. In 1903 an attempt was made to re-establish the crop, and seed of Sea Island and Egyptian varieties was imported and hybridization work begun. Experimental work continued for several years, the results of which were summarized by Harrison and Bancroft at the West Indian Agricultural Conference in 1915. In spite of the comparative success of these hybrid cottons in small-scale experiments, however, there is nowhere any evidence of their having been cultivated to any large extent commercially, and interest in them appears to have evaporated rapidly.

19. CYPRUS: COTTON CROP. (*Ann. Rpt. Dept. Agr.*, 1948.) The shortage of spring rains resulted in loss of soil moisture and irrigation waters, and in consequence production of cotton was, in general, below normal. Cultivation of the variety Coker 100 is extending.

20. COLONIAL SUMMER CONFERENCE ON AFRICAN AGRICULTURE. (*Crown Col.*, October, 1949, p. 602.) The Colonial Summer Conference on African Agriculture was held in Cambridge from August 15 to 27, 1949, under the chairmanship of Mr. Andrew Cohen, of the Colonial Office. Besides numerous officers concerned with agriculture in the African Colonies, it was attended by officials from the Colonial Office and by a number of visitors and foreign observers. The members resolved themselves into study groups in order to examine different aspects of the subject of the Conference, namely: Agricultural Objectives and Organization; Agricultural Objectives and Techniques; Land Tenure; Social Aspects of Agricultural Development; Marketing of Agricultural Products; Administrative Organization required to foster Agricultural Development. The reports of the groups were later debated by the full Conference.

21. EAST AFRICAN RESEARCH. (Committee for Colonial Agricultural Animal Health and Forestry Research, Fourth Ann. Rept., 1948-49. H.M.S.O. Price 2s. 6d.) It is stated in this report that the headquarters of the East Africa Agriculture and Forestry Research Organization and the joint Animal Husbandry Section of this organization and of the East African Veterinary Research Organization are to be established at Muguga, seventeen miles west-north-west of Nairobi. An area of a thousand acres, a part of the Muguga forest reserve, is being leased for a period of ninety-nine years. A Colonial Development and Welfare Research scheme has been made to provide funds amounting to £325,000 for the capital cost of the first phase of the development of the joint headquarters at Muguga and for the laboratories at Kabete for the East African Veterinary Research Organization. It is estimated that a further sum of the order of £500,000 will be required for the second phase to enable the capital development of the joint headquarters at Muguga to be completed.

22. KENYA: COTTON CROP, 1948-49. (*Cott. and Genl. Econ. Rev.*, 16/9/49.) In Kenya about 6,000 bales were marketed in the Nyanza Province and about 2,200 bales in the Coast Province, making a total of 8,800 bales.

23. NYASALAND: COTTON CROP. (*Cott. and Genl. Econ. Rev.*, 23/9/49.) In the Northern Province arrangements were made to purchase the last of the 1948-49 crop at the end of July. Only 38 tons of cotton seed have been taken instead of the 75 taken last year, and it is feared that yields will be low owing to lack of soil moisture. In the Southern Province the lack of mid-season rains has seriously affected yields and the estimate has been reduced from 2,200 tons of seed cotton to 1,800. Except among the early plantings of the Lower River, the incidence of boll-worm is reported to be low.

24. NYASALAND: CROP PROSPECTS, NORTHERN PROVINCE. (*Cott. and Genl. Econ. Rev.*, 11/11/49.) The Northern Province crop is not expected to yield more than 150 tons of seed cotton. The completed garden census shows 1,470 growers on 1,480 acres compared with last year's figures of 2,714 growers on 3,250 acres.

25. NYASALAND: CROP PROSPECTS. (Dept. Agric. Rept., August, 1949.) A total of 472 short tons of first-grade cotton has been purchased in the Karonga district. In addition to this there was a small amount of second-grade cotton, but the weight is not yet known. The census of the present crop recently planted is incomplete, but it is reported that 50 per cent. promises well with the remainder poor, mostly through lack of moisture.

Figures of the small Central Province crop show that 28½ short tons of seed cotton were purchased at Kota Kota markets and 6¾ at the Dowa markets. Figures from Dedza are still awaited.

In the Southern Province marketing commenced in a small way at the end of August, but it is expected that the busiest buying will take place about the third week in September. It has been necessary to reduce the estimates still further to 1,530 short tons, 1,450 of which should come from the Lower River.

26. SOUTH AFRICA: SOIL CONSERVATION. (*Countryman*, Cyprus, **3**, 10, 1949, p. 11.) The Government of South Africa has decided to give direct financial assistance to encourage soil conservation works. A subsidy of 50 per cent., or a rebate of 50 per cent. on a loan, will be granted on soil conservation and reclamation works such as the construction of contour banks. Similar aid is to be given for fencing material, for re-established vegetal cover on eroded areas, and for the construction of farm dams for irrigation and other purposes. A limit is placed on the amount of aid given to individual farms.

27. SOUTHERN RHODESIA: EXPANSION OF COTTON INDUSTRY. (*World Crops*, **1**, 2, 1949, p. 54.) The 1948-49 cotton crop has broken all records for the territory. To keep pace with the increasing supply a second mill of similar design and capacity is being built near the original mill and should be in operation towards the end of 1950. The new plant will comprise 17,500 ring-spinning spindles and 850 doubling spindles. Native labour in Rhodesia has proved adaptable to cotton farming, and the Mondoro Reserve is becoming one of the richest cotton-producing areas in the colony. In 1947 the natives produced approximately 75,500 lb. from their smallholdings. Last year the figure had risen to 259,000 lb., and this year the cotton mills have purchased more than 1,000,000 lb. of raw cotton for £34,429 from native growers. Generally, the natives' yield per acre is far in advance of the Europeans', and the quality of cotton produced is also superior. The average acre yield in the native areas is almost 800 lb. The quality of Rhodesian cotton is partly due to the Research Branch of the Cotton Breeding Station at Gatooma. After twenty-five years' research they have bred a hardy strain of cotton well suited to Rhodesian conditions.

28. SUDAN: COTTON CROP, DAMAGE BY INSECT PESTS AND DISEASES. (*Ann. Rpt. Dpt. Agr.*, 1948-49.) *Egyptian Varieties.*—Although a heavy attack had been expected early in the season, jassid infestation in the Gezira generally was less than for several years past. Control in gardens during the dead season was a failure as re-infestation soon occurred. Acacia trees are suspected as the source of this re-infestation. Nearly 78,000 feddans were sprayed in the Gezira and 15,000 in the White Nile Alternative Livelihood Schemes. Eight thousand seven hundred feddans were successfully sprayed by helicopter. Analysis of 1947-48 yields and spraying dates indicates that early spraying gives the best results.

In the Gezira there was less pink bollworm than in 1947-48, but Egyptian bollworm was worse than usual, though still less than pink bollworm. There are indications that DDT may have caused an increase in Egyptian bollworm. In the White Nile Schemes yields were greater than had been forecast in January, and this was partly attributed to the comparative absence of bollworm. Pink bollworm was unimportant in the Gash and Tokar, but Egyptian bollworm caused considerable shedding of buds and small bolls. Sudan bollworm was worse than usual in the Gash, where it appears to be on the whole the most serious bollworm. Cotton thrips caused some damage in the Central and Southern Gezira, and did severe but local damage in some White Nile schemes. In the Gash damage was caused by the early thrips. Investigations at Tokar showed that the capsid bug (*Creontiades*) and Egyptian bollworm were responsible for a considerable amount of shedding of buds and small buds. Control by DDT is suggested. Cotton aphis was very bad at Tokar and caused a large reduction in yield.

Blackarm was not serious anywhere except in a few plots which had primary infection owing to the seed not having been properly disinfected. Leaf curl also was not serious, but further experiments in the transmission of leaf curl by means of whitefly from plants suspected of harbouring the disease were carried out. A feature of the 1948-49 crop was the appearance of many of the bolls when they opened. The lint remained compact instead of fluffing out, and the locules often remained partly attached to each other. This had an adverse effect on grade, but did not apparently reduce the yield much. A phenomenon of the season was the small amount of boll shedding, and it is suggested that this may be connected with the bad opening—the plant carrying more bolls than it was able to nourish.

American Varieties.—Boll examination in Kadugli area showed an increase in pink bollworm and a moderate infestation by Egyptian bollworm, while Sudan bollworm was negligible. Infestation of stainer bugs in Kadugli area was the lowest for some years, due no doubt to the droughty conditions. They were numerous in open bolls in Equatoria in December and are suspected of being partly responsible for poor seed germination. The cotton leaf roller caterpillar was worse than usual at Kadugli. Jassids caused damage in Equatoria. The capsid bug was found to be a serious pest at Zeidab. Small-scale spraying indicated that application of DDT at the right time would be effective against this pest. Blackarm was the only disease of note at Kadugli Farm with an effect most marked on the late plantings of the susceptible Pump Scheme Strain. The value of the resistant gene B_2 in the commercial crop (S.P.84) was amply demonstrated.

29. RESEARCH CARRIED OUT IN TOKAR DELTA. By D. W. Mollison. (Res. Div., Min. Agric., Sudan. Ann. Rpt. No. 18, 1949.) In recent years attention has been drawn to the loss of the bottom, early crop of long-staple cotton in the Tokar Delta. It was suggested that the loss was due to the hababai, a searing, dusty, north-easterly wind prevalent in October and November; a capsid bug, *Creontiades pallidus;* and possible physiological causes. A programme of investigations into these causes was drawn up under the following headings: Observations on Insect Pests, Causes of

Shedding, and Yield Experiments. The investigations were carried out by an entomologist on contract from Messrs. Pest Control, Ltd., between October, 1948, and March, 1949.

From the first investigation it was found that the major pests in the period under observation were Egyptian and American bollworms, *Creontiades* and aphis, with cotton jassid of lesser importance. For the second investigation a random collection of sheds was made throughout the period in different parts of the Delta and compared with those collected from an enclosed area. Analysis of data from the enclosed plot and generally in the Delta indicated that, up to the end of January, when the bottom bolls were fully grown, about 60 per cent. of the sheds were due to bollworm and *Creontiades*. After January and particularly in March the percentage of sheds due to unknown causes increased and it seems reasonable to assume that aphis was the predominant cause.

From the several yield trials carried out, it was concluded that plots sprayed with DDT gave a very large increase in yield, while those sprayed with sodium dihydrogen phosphate gave a relatively small increase. The evidence indicated that a major loss of crop resulted from damage by insects controllable by DDT—bollworm, *Creontiades* and jassid.

30. Report on the Genetics and Plant Breeding Work carried out at the Shambat Station, A.E. Sudan. (*Ann. Rpt. Dpt. Agr., Sudan*, 1948-49.) The production of a Domains Sakel type resistant to blackarm is complete as regards the gene B_2 and the product BAR14/7 will be used to sow the whole of Gondal Scheme next season and some 350 acres in the Gezira. Straight selection within this type has yielded a leaf curl and blackarm resistant strain of which one acre was grown this season under the number BLR14/16. The addition of B_3 to BLR14/16 is proceeding.

In breeding for jassid resistance all crossing was switched to BLR14/16 as the backcross parent (in place of Domains Sakel and BAR14/7). It has been shown that the full hairiness of several *G. hirsutum* types is transferable by a process of backcrossing alternating with selfing. This work has been greatly handicapped by two seasons of severe leaf curl. Now that BLR14/16 is available as a backcross parent, the position will rapidly improve.

In the transference of lint strength from *G. thurberi* to Sakel, the third backcross of the hexaploid *G.* "*thurbadense*" with Sakel was grown. This suffered an extremely heavy leaf curl attack, but enough lint was produced for a preliminary examination and several plants were selected which appeared to carry the extra strength.

31. Sudan: Jassid Control by Helicopter Spraying. (*Crown Colst.*, November, 1949, p. 714.) The first helicopter ever to be transported from England by air arrived in Khartoum in September. It had been sent by Pest Control, Ltd., for spraying jassid and white fly in the Gezira cotton area. It was estimated that combination of the helicopter and a team of tractors working day and night could complete the spraying in fifty days.

32. Sudan: Plans for Gezira Nationalization. (*Crown Col.*, October, 1949, p. 648.) The Sudan Executive Council have made the following recommendations on the administration of the Gezira Scheme when the Government takes over from the Sudan Plantations Syndicate and the Kassala Cotton Co. at the end of June, 1950.

It is proposed that management of the scheme should be taken over by a Gezira Board consisting of the Financial Secretary, the Governor of the Blue Nile Province, a managing director to be appointed by the Governor-General, and three other members (of whom at least two must be Sudanese) appointed by the Governor-General. The Board would be responsible through the Financial Secretary to the Executive Council, of which at least half the members are Sudanese. The recommendations also provide for a Gezira Local Committee, of which half the members would be Sudanese, to advise the Board on and to initiate proposals concerning all matters affecting the welfare of the inhabitants. As it is the Government's intention to devolve full responsibility for the management of the scheme on to Sudanese as quickly as possible, the first Sudanese inspectors will be appointed this year.

In 1948 cotton and cottonseed, of which the greater part came from the Gezira, contributed nearly four-fifths of the value of all the Sudan's exports; and in 1949 the Government's share from the sale of Gezira cotton will amount to more than one-third of the revenue of the Central Budget.

33. TANGANYIKA: COTTON CROP. (*Cott. and Genl. Econ. Rev.*, 21/10/49.) Deliveries continue to come in well at Mwanza, and it is considered that the official estimate of 34,000 bales will probably be exceeded. Markets in British East Africa are well stocked with imported textiles. No further import licences for Japanese goods are being issued for Uganda and Kenya, and in Tanganyika the issue of Indian import licences has also been suspended.

34. TANGANYIKA: COTTON CROP. (*Cott. and Genl. Econ. Rev.*, 28/10/49.) Cotton sales in the Mwanza District were 22,594 bales up to September 7. The cotton crop in the Eastern Province is exceptionally clean. Marketing and ginning are in full progress. The yield is estimated 20 per cent. higher than in 1948.

35. THE MAINTENANCE OF SOIL PRODUCTIVITY IN SUKUMALAND AND ADJACENT AREAS, TANGANYIKA. By J. E. Peat and A. N. Prentice. (*E. Afrn. Agric. J.*, xv, 2, 1949, p. 48.) Sukumaland, roughly a third the size of England, occupies much of the Lake Province of Tanganyika. The Wasukuma tribe numbers well over a million people. The adjacent areas of Musoma District, Uzinza sub-district (an overflow area for Sukumaland), and Ukerewe Island, differ somewhat from Sukumaland, but have many problems or future problems in common. The overall density of population in Sukumaland is probably of the order of 70 to the square mile, but because of the marked maldistribution—even within Sukumaland about half the area is not effectively occupied—much of the countryside has an agricultural population as dense as 200 or more to the square mile.

Information on soil-productivity problems has been gathered over the past decade from the experiment stations of Ukiriguru (18 miles from Mwanza in the broken hill-sand country) and Lubaga (near Shinyanga, 80 miles south of Ukiriguru) and their satellite district plots. As one of the authors has been transferred to Uganda after ten seasons in Sukumaland, it seemed timely to record facts and views, but it is emphasized that this is in the nature of a progress review.

Sukumaland and some of the adjacent areas have been supporting for generations and still support a heavy population. Considering the semi-arid climate and the bad farming, the soils cannot be inherently poor, but the population is rising and the problems of maintaining yield and output have become insistent. Using crop-yield as the yardstick of productivity, yield is discussed as influenced by various treatments on two major soil types of the countryside, a light and a heavy, represented by Ukiriguru and Lubaga respectively. On the deep, light soil there is an appreciable response to manuring, both immediately and residually, the latter being a very important point; on the shallower heavy *ibushi* soil there is a much smaller response. On neither soil are the responses as good as had been hoped from grass-rest or other resting treatments. Both soils, but more especially the heavy, derive marked benefit from tillage by ridging plus tying. On both again a worth-while benefit may show from simple arable rotation. These broad statements, of course, need modification in detail, and in part should be qualified by " so far as the work has gone." The view held in the light of present knowledge is that productivity can be increased by: (*a*) more intensive (and quite feasible) manuring on the light soil, bearing in mind that the light-soil area is in broken country and is interspersed throughout with heavier soils which assist in feeding the light; (*b*) improved tillage on both soils, and (*c*) some rotation of arable crops.

36. UGANDA: COTTON CROP, 1946-47. (*Ann. Rpt. Dpt. Agr. Admin. Work*, 1947. Received 1949.) The report includes notes on the 1947-48 crop in the Eastern, Buganda, Northern and Western Provinces of Uganda. Remarks on the insect pest damage sustained by the crop in each area are also included.

37. UGANDA: PURCHASE OF 1949-50 COTTON CROP. (*Cott. and Genl. Econ. Rev.*, 18/11/49.) The entire new Uganda cotton crop has been sold through the Lint Marketing Board to Great Britain and India at a price based on 30d. per pound f.o.b. Mombasa for BP52 quality. The general reaction to price obtained is favourable. It is hoped that the Price Assistance Fund, instead of being subject to a drain, will increase by at least £5 million.

The cotton-buying season is likely to commence about mid-December in Usuku County, mid-January, 1950, in the Eastern Province, and after the usual three weeks' lapse of time, in the Buganda Province. This proposal is considered satisfactory all round. The Uganda Government has announced an increase of Sh. 3s. per 100 lb. of seed cotton to the growers over last year's figures of Sh. 30s. This is a very welcome step towards concrete financial incentive to the grower to grow more cotton. Moreover, this increase of Sh. 3s. per 100 lb. of seed cotton will give an extra £700,000 to the growers.

38. UGANDA: COTTON PRODUCTION. (*Crown Colst.*, November, 1949, p. 711.) Cotton production figures for the year 1948-49 show the total sold has been approximately 377,231 bales, of which 100,412 were on the free market and 94,900 bales were shipped to Liverpool. The amount of cotton-seed oil available for export, other than to Kenya, has been 60,250 tons. Approximately 12,000 tons additionally will be crushed in Uganda for Kenya requirements, but there will be in consequence a further tonnage of cotton-seed cake for the United Kingdom. So far 48,500 tons of cotton-seed oil have been exported to the United Kingdom, leaving approximately 11,500 tons still to go forward.

39. UGANDA: COTTON CROP, 1949-50. (*Cott. and Genl. Econ. Rev.*, 4/11/49.) Weather conditions were favourable over the greater part of the Protectorate and the crop made good growth. Planting was completed and the total acreage, although it has yet to be revised, is estimated at 1,596,352 acres, which corresponds closely with last season's figure. The incidence of diseases and pests is not unduly high except in Mbale District, where severe blackarm damage is reported. Early plantings are setting a good bottom crop and flowering has been satisfactory on the later plantings. Provided favourable weather conditions continue, production at a satisfactory level for a crop which in general is late planted should be obtained. A crop of about 325,000 bales is estimated.

40. UGANDA: OWEN FALLS POWER STATION. (*Corona*, 1, 10, 1949, p. 6.) A contract for the construction of the dam and hydro-electric power station at Owen Falls has been awarded to a group consisting of one Danish, three British and four Dutch firms. The amount of the contract is £3,639,540, most of which will be spent in the United Kingdom and in Uganda. It is estimated that it will take four years to complete the work.

41. FERTILIZER STUDIES ON UGANDA SOILS. By H. L. Manning and G. ap Griffith. (*East. Afrn. Agric. J.*, xv, 2, 1949, p. 87.) This article records the results of a series of experiments covering three years on the response of food and export crops (including cotton) to the application of fertilizers. In view of the opening up, during 1946, of an extensive rock phosphate deposit near Tororo, and the consequent local availability of rock phosphate and of soda phosphate (produced by calcining rock phosphate with crude sodium carbonate from Lake Majadi in Kenya) and of the prospect of cheap nitrogenous fertilizers from the development of hydro-electric power, particular attention was given to the effects of these phosphatic materials and of sulphate of ammonia. Potash, dung, lime and latterly double superphosphate were also used in the trials. Applications were made by broadcasting and by localizing the fertilizer in drills and at different stages of growth.

Yield responses have been reported for a number of crops. These crops included finger millet, maize, sweet potatoes, sugar cane, groundnuts, sorghum and cotton. Of all fertilizers tried, only nitrogen led to appreciable yield increases. Indeed, it is abundantly clear that the mere application of artificial fertilizers does not provide a substitute for inefficient cultural practices. For example, Manning (1949) has shown that a very considerable increase of cotton production may result from sowings near an optimum sowing date. Yields per acre from experiment stations often exceed 1,000 lb. By contrast, yields from smallholdings on the same areas are estimated to be about 500 lb. per acre. Again, where rainfall is marginal, the moisture conservation which would result from efficient methods of ridge cultivation might have far-reaching importance. The relatively small yield increments so far shown to result from the use of artificial fertilizers can, therefore, have no real significance until existing systems of native agriculture adopt the major improvements demonstrated on the experiment stations.

There is sufficient evidence to show that nitrogenous fertilizing without parallel studies of the amount of accumulated nitrogen and the mechanism of its origin would be of limited practical value. The fact that a peak of these accumulations coincided with the likely onset of flowering of June-planted cotton may be of far-reaching importance in improving average yields per acre. Should this accumulation be recorded over areas outside of the elephant grass regions its importance would be further enhanced.

No spectacular increases may be expected from applications of rock or soda phosphate. Even superphosphate has led to only small responses except on impoverished soils. Possibly fractional applications of rock or superphosphate may lead to larger responses. Further, the continuous broadcast application of rock phosphate —by far the cheapest source of phosphate in East Africa—may lead eventually to satisfactory yield increases.

Applications of sulphate of potash have given uniformly poor responses. Experiments with cotton on the three major experiment stations, and one with sugar cane, indicate that there is no obvious potash deficiency.

These experiments conducted over several years and with various crops have shown that primary expectations of large yield responses to fertilizers have not been fulfilled. More detailed and necessarily slower work, which must now follow, may lead to larger yield responses. Foremost among the new series of experiments are the investigations regarding the source, duration and magnitude of accumulated nitrate nitrogen.

42. FERTILIZER MANUFACTURE IN UGANDA. (*Crown Colst.*, October, 1949, p. 608.) Four experts from Uganda, including Mr. C. R. Westlake, chairman of the Uganda Electricity Board, have visited America to study certain processes of manufacturing phosphate fertilizers used by the Tennessee Valley Authority. The Authority's hydro-electric resources are used in the preparation of these fertilizers from local materials, and it is thought that Uganda's great hydro-electric project—the harnessing of the Owen Falls—may make possible similar developments in connection with the Tororo rock phosphates, which are in the vicinity of the Falls.

The Uganda ore differs materially from those mined in the U.S.A. in that the chief impurities are iron minerals, the behaviour of which cannot be predicted. New investigations which are now being put in hand by the Uganda Government will cover the utilization of by-products, including production of iron; the possibility of large-scale production of charcoal for use as a reducing agent in the manufacture of elemental phosphorus and iron metal; and the possibility of obtaining supplies of sulphur or pyrites for the manufacture of sulphuric acid. While emphasis is laid on establishing a phosphatic fertilizer industry, the possibility of making nitrogenous fertilizers is also being considered.

43. WEST INDIES: SEA ISLAND COTTON CROP INCREASE. (*Crown Colst.*, November, 1949, p. 724). The area under Sea Island cotton in the British West Indies at March of this year was more than 12,000 acres, and the yield for 1948-49 was estimated at about 5,600 bales. Barbados was expected to produce more superfine cotton and St. Vincent also was expected to show an increase in its production, despite competition from groundnuts. The area planted with cotton for the 1947-48 crop has been returned as 9,386 acres, which is an increase of more than 2,000 acres compared with the previous season.

The total acreage planted for the current crop in Antigua was 3,500 acres, 80 per cent. of which was peasant-owned. Estimated exports of clean lint have been put at 2,000 bales, the value of which was about £100,000.

COTTON IN THE U.S.A.

44. United States: Crop Prospects. (*Cott. and Genl. Econ. Rev.*, 30/9/49.) The domestic supply of cotton for 1949-50 is indicated at about 20 million running bales, and will consist of the carryover at the beginning of the season of 5·3 million bales, the 1949 crop of nearly 14·6 million bales and imports of about 0·2 million bales. The 1949-50 supply will be about 12 per cent. larger than the 17·9 million bale supply of last season, and of the post-war years will rank second to 1945-46, when, with a carryover of over 11 million bales, the supply totalled nearly 20·5 million bales.

45. United States: 1949 Crop. (*Cotton*, M/c., 26/11/49.) The weather in the Eastern and Central Belts has recently been very favourable for harvesting, mostly clear, with temperatures slightly above normal. These conditions were probably the best of the entire season for the gathering of the crop. As a result, the movement was accelerated and heavy in the northern sections. Freezes have been few, but frosts in many areas have caused defoliation. Nearly all cotton is open and picking is being rapidly completed. Recent receipts have ranged in value from bright Strict Low Middling to Low Middling, with some Strict Good Ordinary.

In Texas and Oklahoma there has been practically no rain, the weather being open and clear, perfect for picking. Consequently, grades have held their own, brightened to some extent, and have not been as low as expected. In West Texas Strict Low Middling and Low Middling values predominate. In other sections grades are somewhat duller and lower. Strict Good Ordinary is in very limited supply.

In New Mexico the weather was clear and warm; in Arizona and California light rains fell and temperatures have been about normal. Frosts, sufficient to defoliate the plant, have not affected the yield. It is reported that about 800 mechanical harvesters were operating in California at the end of October. The movement in these irrigated sections has been very heavy. Grades from now on are expected to be middling and below.

46. United States: Cotton Crop Carryover. (*Cotton*, M/c., 22/10/49.) This year's carryover is the highest in grade since 1941 and in staple length the longest in history. Most of the cotton is above Strict-low-middling and more than 70 per cent. of the cotton runs $1\frac{1}{32}$ to $1\frac{3}{32}$ inches in staple. Of the total carryover of $5\frac{1}{4}$ million bales, 3,800,000 are owned by the Commodity Credit Corporation. The 1949 carryover plus the indicated crop should put the supply for this season up nearly to 20,000 bales, which implies that next year's carryover is likely to be much larger.

47. United States: Cotton Crop, 1950. (*Cotton*, M/c., 26/11/49.) The Secretary of Agriculture has proclaimed a national marketing quota of 11,733,750 bales (standard bales of 500 lb. gross weight) for the 1950 cotton crop and announced a national acreage allotment of 21 million acres. At the same time he announced a national referendum to be held on December 15, 1949, in which farmers will vote for or against the marketing quota.

Under provisions of the Agricultural Adjustment Act of 1938, the Secretary must proclaim a national marketing quota whenever he finds during any calendar year that the total supply of cotton for the marketing year beginning in such calendar year exceeds the normal supply for that marketing year. However, the law specifically requires that for the 1950 crop, whatever the total supply may be, the national acreage allotment shall be not less than 21 million acres. The marketing quota of 11,733,750 bales is arrived at by multiplying this figure by the average annual yield (1944-48) of 268·2 lb. per planted acre.

48. United States: Cotton Crop, 1950-51. (*Int. Cott. Adv. Cttee. Monthly Rev.*, September, 1949.) According to the Cotton Production Review a further expansion in the cotton area in the United States would be attractive to farmers, but the disposability of the crop constitutes a major problem. Some 36 per cent. of the

1948-49 crop was entered under loan arrangements and some 26 per cent. ultimately passed into Government ownership in accordance with the United States price support laws. In view of the accumulation of a surplus, new legislation preparatory to acreage control was enacted on August 29, 1949. If the total supply this season (carryover plus production) is greater than the normal supply (130 per cent. of expected domestic consumption plus exports during the current season), marketing quotas on the 1950 crop are to be proclaimed. The legislation provided that the 1950-51 allotment cannot be less than 21 million acres (the 1949 planted acreage was over 26 million acres).

49. COTTON BREEDING METHODS IN THE UNITED STATES OF AMERICA. By G. A. W. Wagenaar. (*Landbouw*, **20**, 1948, p. 85. From *Pla. Bree. Abs.*, xix, **2**, 1949, p. 345.) The two main objectives are quality and resistance to diseases and pests. The most important tasks of the breeders are to keep the seed pure during multiplication and to improve it gradually. Some work is being done on producing new varieties—*e.g.*, in the eastern states attempts are still being made to produce a variety with the quality of Sea Island but with shorter period of growth and less susceptibility to boll weevil attack, which can be cultivated in districts infested with this pest. Experience in Africa, India and on a small scale in Java has shown that American Upland cottons possess sufficient variability to adapt themselves to very varying environments. These should be crossed with varieties indigenous in Indonesia to obtain varieties suitable for growing there with a staple of about 1 inch.

50. UPLAND COTTON PRODUCTION IN ARIZONA. By W. I. Thomas. (Agric. Expt. Sta., Tucson, Arizona, Bull. 214, 1948.) Interest in Upland cotton developed in Arizona shortly after the first World War. Since that time Upland cotton has become the major cash field crop of the State and by 1947 occupied one-quarter of the cultivated acreage. In the past twenty-five years many experiments in its culture have been made, new varieties and strains of cotton have been developed, machinery has been improved, marketing has become more systematic and certain new insecticides and fungicides are available for insect and disease control.

To maintain production of this crop on high-cost, irrigated lands every effort is made to maintain heavy yields per acre of quality cotton, and experimental work has been designed to investigate the production and quality aspects of cotton. This publication is an effort to summarize the information obtained from many experiments and surveys made by the Agricultural Experiment Station.

51. ACALA COTTON IMPROVED STRAINS: CULTIVATION IN NEW MEXICO. By G. N. Stroman. (Bull. New Mexico Agric. Exp. Sta., 337, 1948. From *Summ. Curr. Lit.*, xxix, **18**, 1949, p. 331.) Cotton breeding work was begun in 1928 at the New Mexico Agricultural Experiment Station in co-operation with the U.S. Department of Agriculture. Four strains of Acala cotton have so far been distributed to farmers. The breeding programme includes progeny tests and preliminary and advanced strain tests. A summary is given of the results of the various strain tests carried out during the period 1942-45, and of the spinning tests carried out on old and new strains developed at the station.

52. CLEAN LOW-GRADE COTTON. (*Cott. and Genl. Econ. Rev.*, 4/11/49.) Approximately half of this season's cotton crop from the Mississippi Delta area will be ginned on a new type of gin which cleans the cotton. As these gins remove most of the leaf and trash from the lint, it is expected that the amount of clean low-grade cotton available will, in future, be considerably increased.

53. SHORT HARSH COTTON. (United States Tariff Commsn. Rpt. No. 156, 1947.) The short harsh Asiatic cottons, considered desirable for certain purposes because of their resilience, are not grown in the United States. In the first place, demand in the United States for cottons of these types is ordinarily exceedingly limited compared with demand for American-type cotton. Secondly, the short harsh Asiatic cottons do not give adequate returns per acre to warrant serious attempts at cultivation in the United States. Imports of harsh cotton have a more significant effect upon the consumption, stocks, and prices of very short staples and low grades of American cotton than upon cotton of long staple and of medium or high grades. This report gives an analysis of the statistics relating to cotton of very short staple and of low grades.

54. Import Quota for Long-staple Cotton. (*Cotton*, M/c., 8/10/49.) The import quota year for long-staple cotton was changed from the year beginning September 20 to February 1, by Presidential proclamation on September 3. The proclamation further provides for the importation of, or withdrawal from, bond of 16,487,042 pounds between September 20, 1949, through January 31, 1950, to cover mill requirements between now and February 1. The annual long-staple global quota of 45·7 million pounds of cotton 1⅜ in. to 1$\frac{11}{16}$ in. was unchanged.

55. Tenth Annual Report of Activities, National Cotton Council of America, 1949. This report reviews the year's work of the Council, whose activities are concerned mainly with the organization of campaigns to popularize the many ways in which cotton and its by-products serve the consumer market.

56. Agricultural Statistics, 1947. U.S. Department of Agriculture. (For sale by the Superintendent of Documents, U.S. Govt. Printing Office, Washington, 25, D.C. Price not stated.) This is the thirteenth issue of this publication, prepared under the direction of the Yearbook Statistical Committee. It includes statistics of grains, cotton, sugar, tobacco, oilseeds, fats, oils, fruit, vegetables and minor field crops. Also included in this issue are statistics concerning the foreign trade of the United States, and agricultural conservation and forestry.

COTTON IN EGYPT

57. Egypt: Cotton Crop. (*M/c. Guardian*, 7/10/49.) An area of 1,648,000 feddans has been planted with cotton in Egypt this year, or about 14½ per cent. more than was planted last year. While, however, 940,000 feddans have been planted with long-stapled varieties, against 464,000 feddans last year, and 160,000 feddans with medium-stapled varieties, against 139,000 feddans, the area under the shorter-stapled varieties has been reduced by 250,000 feddans, to 588,000 feddans. This reduction has come about mainly through a substitution of Karnak for Zagora in the Delta. The Egyptian Ministry of Agriculture has now issued its first estimate of the outturn of the current crop, indicating a total yield of 7,691,000 cantars. This shows a reduction of 1,064,000 cantars, or about 12¼ per cent., compared with last season's actual production. The reduction in the estimated yield in spite of the substantial increase in the area planted is the result of the unusually heavy damage which the plants have suffered this summer from the cotton worm. But for this damage the area planted could easily have produced a crop of 9,000,000 or 9,250,000 cantars. Traders, however, consider that the authorities have made a generous allowance for insect damage in their first estimate and that the final figure is likely to be much nearer 8,000,000 cantars.

This year's crop of Karnak is estimated at 2,511,000 cantars, compared with 1,978,000 cantars last season and 1,292,000 cantars in 1947-48, but with 3,499,000 cantars in 1946-47. There is a big increase also in other long-stapled varieties, but the medium-staples show a decline, and the short-staples (which will now comprise little beyond Ashmouni) are expected to total only 3,810,000 cantars this season, showing a decrease of about one-third compared with the previous crop.

58. Egypt: Cotton Exports. (*Cott. and Genl. Econ. Rev.*, 21/10/49.) Egypt's cotton exports of 1,611,000 bales were 44,000 higher than in 1947-48 and the highest since 1939-40. The rise in exports in post-war years has exceeded the rise in production, thus reducing end-season stocks each year. Old-crop stocks on hand August 1, 1949, together with the 1949 crop, however, will provide an export surplus of over 2·1 million bales for 1949-50. This is considered as more than sufficient to meet all probable demand this year.

59. Egypt: Raw Cotton Exports. (Pakistan Fortnightly Cott. Rept., 16/10/49.) Raw cotton exports from Egypt from September 1, 1948, to August 31, 1949, total 1,044,423 bales, compared with 1,072,361 bales during the corresponding period in the previous season. Great Britain accounted for 322,936 bales against 265,866 bales; the Continent 410,467 bales against 553,505 bales; India, China and Japan 304,969 bales against 165,709 bales; and the United States of America 6,051 bales against 87,281 bales.

60. Cotton in Egypt. By R. P. Dunn. (Nat. Cott. Council, U.S.A., 1949. Price 35c.) This report is an effort to describe the cotton and cotton textile industries in Egypt and to point out some of the problems and opportunities regarding future development. At the present time the crop is produced largely by hand in much the same manner as it was a century ago. Labour is abundant and cheap, and gives little incentive to the introduction of mechanical equipment.

Because of the accumulation of cotton occasioned by the war, production control programmes were instituted in 1942 and have been maintained to date. As a result the area planted to cotton was reduced from 1,700,000 acres in 1941 to 725,000 acres in 1942. After the first drastic reduction, acreage was increased slowly, reaching approximately 1,000,000 in 1945 and 1,300,000 in 1946 and 1947. Though the acreage is still controlled, the extremely high prices in Egypt have undoubtedly induced the planting of lands outside the permitted acreage, with the result that the total area forecast for 1948-49 is approximately 1,400,000 acres.

The general objective of plant breeding and production in Egypt has been speciality cotton of $1\frac{1}{8}$ in. and longer in staple. With the development of Giza 30, the Egyptian crop now includes a complete range of staples from Zagoras at $1\frac{3}{32}$ in. to Amoun which ranges from $1\frac{7}{16}$ in. to $1\frac{1}{2}$ in. The report includes a short history of the leading commercial varieties and gives a brief description of the diseases and insect pests which attack the crop. Rigid control is exercised over seed and areas seeded to varieties, and a high standard of grading and blending is maintained.

The textile industry, insignificant in 1930, now produces about 300,000,000 yards annually. Egypt has thus become virtually self-sufficient as regards cotton textiles, importing at the present time only 25,000,000 yards annually—about 8 per cent. of its domestic consumption. A small quantity of yarn and fabric is exported. Although the industry includes numerous mills, two companies share about 60 per cent. of the half-million installed spindles. Labour costs are low, but productivity compares favourably with the average for the United Kingdom and the Continent. The industry uses only the long Egyptian cotton in all counts and qualities of yarns, and this under-spinning makes the cost of cotton in the lower counts comparatively high. It is suggested that it would be profitable to import shorter staples to supply the growing industry.

COTTON IN OTHER FOREIGN COUNTRIES

61. Argentina: Cotton Crop, 1948-49. (*Cott. and Genl. Econ. Rev.*, 28/10/49.) The final figures for the 1948-49 crop would appear to be about 95/96,000 tons, and of this quantity rather more than 15,000 tons has gone into the hands of the Sobreprecio Committee of the Direccion de Algodon. Ample rains have fallen in the cotton zone, and sowings have been effected in 50 per cent. of cases. It is probable that the acreage planted to cotton will be the same as last year despite all the difficulties the farmers experienced during the past season with regard to pickers, etc. Unfortunately, locusts are present in the cotton zones and damage has been reported.

62. Argentina: Cotton Crop Prospects, 1949-50. (*Cott. and Genl. Econ. Rev.*, 18/11/49.) In order to bring about an improvement in the quality of the 1949-50 crop, the Government has approved a plan for the acquisition and distribution of a large quantity of selected seed, and 10,000,000 pesos have been allocated for this purpose. To stimulate increased plantings this autumn, the Government will make a free distribution of 350,000 kilos of seed.

The 1949-50 cotton season has started favourably. Good rains have recently fallen over the cotton zones, and the moisture will help quick germination of the seed planted. In all districts, demand for seed has been heavy, and in some areas the indications point to a 40 per cent. increase in plantings compared with last year.

63. COTTON IN THE BELGIAN CONGO. By R. P. Dunn. (Nat. Cott. Council, Tennessee, U.S.A. Price 35c.) This report describes the status and discusses the future opportunities, problems and limitations of cotton and cotton textile production in the Belgian Congo. It opens with a general description of the territory, its soils and the agricultural system they support, and gives a brief history of cotton growing in the colony from 1917 when it was first introduced as a commercial crop.

The greatest problem facing the Belgian Congo in the development of natural agricultural resources is shortage of labour. Transport also is a limiting factor to further development—in some cases the gins being as far as 2,500 miles from the port of shipment. The crop is cultivated almost entirely by hand, and the only mechanization instituted so far is trucking to expedite transport.

Research on the crop is carried out by the National Institute for Agricultural Study of the Belgian Congo at their three field stations, Mambeza, Gandajyaka and Kivu. In addition a fibre laboratory for the study of the spinning properties of fibres is maintained by the Institute in connection with the University of Ghent. The report includes a list of the most serious pests and diseases. The textile industry at present comprises two established mills, and a third which is still in course of construction.

64. BRAZIL: SÃO PAULO CROP, 1950. (*Cotton*, M/c., 22/10/49.) During an official ceremony to mark the classification of the millionth bale of the 1949 São Paulo cotton crop—this being the first occasion for four years that this figure has been reached—the Secretary for Agriculture stated that his Department was already prepared for the planting of the 1950 crop; seeds would be of better quality than last year, and 1,100,000 bags thereof would be avilable to planters—*i.e.*, sufficient to produce 2,000,000 bales of clean cotton.

The high prices at present ruling for cotton are assisting the Government's campaign for greater production of this commodity. The target for the next São Paulo crop is 400,000 metric tons of clean cotton, but doubts are expressed whether farmers will be willing to allocate sufficient land to ensure such a figure; furthermore, there are fears that the efforts made will be handicapped by the difficulty of preparing the ground for sowing, owing to its extreme hardness resulting from lack of rain. Nevertheless, a substantial increase over the current year's production is expected, some commentators suggesting a crop of 300,000 tons.

65. BURMA: CROP PROSPECTS. (*Cott. and Genl. Econ. Rev.*, 23/9/49.) Estimates of the acreage sown to cotton this season in the districts which submit the first forecasts show 90,800 acres, a decrease of 5,600 acres or 6 per cent. when compared with the corresponding estimates for 1948, a decrease of 134,300 acres or 60 per cent. when compared with the average of the five pre-war years ending 1941. The decrease is due partly to the prolonged break in the middle rains after sowing, partly to insurrection, and partly to competition from imported cotton goods. Owing to lack of sufficient rains after sowing, standing crops are generally poor to fair in condition.

66. CHINA: COTTON INDUSTRY. (*Cott. and Genl. Econ. Rev.*, 16/9/49.) Cotton mill consumption in China has been estimated at 1,850,000 bales (480 lb. net) for the 1948-49 season—a decline from 2,030,000 bales in the previous season and 2,500,000 in the pre-war period. These figures do not include an estimated 1948-49 consumption of 1,250,000 bales in home industries. Cotton mills in the interior have been able to maintain operations at a fairly high level due to easier access to domestic cotton supplies, but mills in the Shanghai area, with about 45 per cent. of China's operable spindles, face a critical situation due to lack of power and of raw cotton.

The 1949-50 cotton crop is expected to be smaller than the 2,115,000 bales harvested last season. The spring drought in north China and recent floods in central China have reduced both acreage and yields in China this season. Without raw cotton imports it is estimated that the mills will have to curtail operation in the 1949-50 season by 45 per cent. over last season. It is evident, therefore, that the Chinese Communists are in desperate need of additional raw cotton imports. The possibilities of supplying such needs, however, now seem meagre. No appreciable fraction of the foreign exchange necessary for such purchases is in sight, and the closure of ports further hinders imports or barter exchange. This year's reduction in food crops owing to floods and drought may make it necessary to plant more crops next year at the expense of cotton. Thus, it seems probable that China will not be able to increase its cotton acreage for at least two more seasons because of the demand on available acreage for food crops.

67. FRANCE: COTTON INDUSTRY. By J. L. Philippot. (*Text. Weekly*, **43**, 1949, p. 1342. From *J. Text. Inst.*, **40**, 8, 1949, p. A355.) Some particulars are given of the raw cotton stocks now held by French interests and of the work of the Groupement d'Importation et de Répartition du Coton in controlling imports and allocations. The assistance of the European Control Administration is mentioned. Under the "Monet Plan" the present 8·4 million spindles should be renovated by 1953 and 2 million modern spindles installed, and the 200,000 looms should be partly replaced by 45,000 automatic looms.

68. FRENCH EQUATORIAL AFRICA: COTTON CROP, 1948-49. (*Cott. and Genl. Econ. Rev.*, 18/11/49.) During the 1948-49 season, 76,460 tons of seed cotton were handled commercially—a quantity only slightly below the previous record of 76,532 tons attained in the 1945-46 season. These tonnages correspond to the exportation of about 25,000 tons of lint. Production in the Oubangui area has held stable at around 35,000 tons of seed cotton over the past ten years, but in the Tchad district the trend has been steadily upward, the 1948-49 yield establishing a new peak at 44,000 tons.

The past season has undoubtedly been good from the cotton-growing standpoint. It is to be hoped nevertheless that average yields per hectare will continue to increase as a result of improved methods of cultivation and the planting of more suitable varieties, and that production will reach an annual figure of 100,000 tons of seed cotton over the next few years. Cotton in Equatorial Africa is all rain-grown.

69. HUNGARY: COTTON CROP. (*Mthly Rev. Wld. Sitn.*, Int. Cott. Adv. Cttee., August, 1949.) Nearly 3,000 hectares are to be devoted to cotton growing in 1949-50 following successful experiments recently carried out. The yield is expected to be 2 quintals of lint per hectare. This would produce a crop of some 2,800 bales. The cotton seed now being used is imported from the Soviet Union and Bulgaria. Plans provide for an extension of the area under cotton to 57,000 hectares by 1954.

70. MEXICO: COTTON CROP. (*Cott. and Genl. Econ. Rev.*, 21/10/49.) The Matamoros crop is ended. Ginnings to date total 292,002 bales and only about 7,000 bales remain to be ginned. Opinions of the Torreon crop are still mixed: estimates seem to run from a low of 175,000 bales to a high of 210,000 bales compared with 193,000 bales ginned last year. In Matamoros farmers are cleaning additional land for next year's crop. Some people seem to be of the opinion that about 200,000 to 300,000 additional acres will be planted with cotton next season and with normal weather conditions it seems reasonable to expect a crop of about 400,000 bales of 500 lb. net.

71. MEXICO: IRRIGATION OF COTTON-GROWING AREAS. (*Mthly. Rev. Wld. Sitn.*, Int. Cott. Adv. Cttee., September, 1949.) Cotton is grown under irrigated conditions in most regions of Mexico, but the most noteworthy expansion is in the Matamoros area. Including the southern delta of the Rio Grande and the valley of San Juan, this area covers about a million cultivable acres, but much of it remains to be cleared. In 1949-50 some 570,000 acres were in cultivation, a substantial part of which was irrigated from the Azucar dam and Culebron reservoir of water from the above-named rivers. Land clearance has, however, been proceeding at the rate of about 100,000 acres a year. Under a United-States Mexican water treaty two or three new dams (the Falcon, the Aqua Verde and another) on the lower Rio Grande are to be constructed and brought into operation from the early 1950's onwards. It is estimated that nine-tenths of the cultivable land in the Matamoros region will thus be irrigable.

72. COTTON CULTIVATION IN RELATION TO SOIL EROSION IN MOZAMBIQUE. By D. H. G. Gouveia. (*Trab. do Cent. de Invest. Cient. Algod.*, 1, 1948.) Some general considerations are made on the soil erosion problem especially stressing the constructive and protective action of natural vegetation. The perfect adjustment Man-Soil is considered of capital importance. Land use must be established according to soil capability and based upon agronomic principles. References are made to the general causes of soil erosion in Mozambique, planning and agrarian investigation of the various ecological zones of Mozambique, agricultural practices according to contour lines and other soil conservation practices, complete protection of erodible areas, veld burning control, propaganda, education of the community and general co-operation. The action of the Junta de Exportação do Algodão Colonial and the Centro de Investigação Cientifica Algodoeira for the control of cotton growing in relation to soil conservation is shown. Finally an appeal is made for the creation of a Department of Soil Conservation in the Colony.

73. PERU: IRRIGATION OF COTTON LAND. (*Cott. and Genl. Econ. Rev.*, 28/10/49.) It is reported that Messrs. Anderson, Clayton and Co., under a contract entered into with the Government, will undertake irrigation works in the department of Ica, from which area a large part of the better grade Tanguis cotton is obtained. It is estimated that this undertaking will enable some 74,133 acres of land to be brought under cultivation and cotton will doubtless be the principal crop. To recompense them for their investment of capital, the Government will, it is stated, grant to Messrs. Anderson, Clayton and Co. property rights in 50 per cent. of the land which the irrigation works will enable to be utilized. The rest of the land will be parcelled out among the small cultivators in the area, the holdings not to exceed about 24 acres per family.

SOIL, SOIL EROSION AND FERTILIZERS

74. WORLD POPULATION AND WORLD FOOD SUPPLIES. By Sir John Russell. (*Nature*, 1/9/49, p. 379.) In his address to the British Association at Newcastle-upon-Tyne on August 31, Sir John Russell summarized the problem of population and supply under the following headings: extension of the food-producing area, soil erosion, intensification of cropping, and new uses of science in food production. Speaking of soil erosion, Sir John Russell said that it could be dealt with much more easily if the problems were solely technical "Unfortunately, the need for recasting the vegetation of a whole catchment area often cuts across all sorts of social or tribal customs, personal or sectional interests, political boundaries, etc., and raises many complex administrative problems. A few recalcitrant objectors could spoil the whole plan; it must be enforceable by law, but voluntary co-operation of all concerned should be the aim."

75. COTTON CULTIVATION IN RELATION TO SOIL EROSION IN MOZAMBIQUE. See Abstract 72.

76. LAND-UTILIZATION IN THE WET TROPICS. By H. A. Tempany. (*Emp. J. of Exp. Agric.*, xvii, 67, 1949, p. 148.) The super-humid tropics present special problems of land-use; the heavy and continuous rainfall, high humidity, and high temperature produce the typical conditions that differ markedly from those of sub-humid regions, with heavily leached soils and rapid disappearance of organic matter when drainage is unimpeded; when drainage is impeded leaching is restrained, mineral fertility is higher, and organic matter accumulates; the soils are heavier and in their natural condition often unusable, but when reclaimed by drainage they may be of great value and have a wider range of uses than upland soils. On uplands, permanent orchard crops are the most suitable form of cultivation as they permit the nearest approximation to natural conditions although limited possibilities in other directions exist. In alluvial lowland areas, although orchard crops may grow well, annual crops can be grown; in particular rice is well suited to such conditions, other annual crops can be grown, and there is some scope for animal husbandry. On this account these regions are specially important from the point of view of food-supply.

77. SOILS RESEARCH SCHEME FOR THE CARIBBEAN COLONIES. (Rept. of the

Governing Body and Principal's Rept. for 1948, Imp. Coll. of Trop. Agric., 1949.) Although the proposals for the centralization at the College of all agricultural research for the British Caribbean Colonies have not yet been accepted in their entirety by the Colonial Office, four of the schemes suggested, namely those dealing with bananas, cocoa, sugar and soils, have been established. The Soils Research Scheme is for a period of ten years in the first instance. It provides for a senior staff of four soil surveyors and three soil scientists to work under the direction of Professor Hardy. The object of the scheme, broadly defined, is the improvement of knowledge of the soils of all the territories in the British Caribbean, with particular reference to their agricultural utilization.

A major part of the programme involves a detailed survey of the soils in all the British Caribbean Colonies, a task which will demand many years' sustained and concentrated work, the importance of which in providing information fundamental to the development of the agricultural possibilities of the British Caribbean can scarcely be exaggerated.

78. NEW DEVELOPMENTS IN SOIL INSECTICIDES. By W. H. Lange. (*Agric. Chem.*, **2**, 9, 1947, pp. 20, 68. From *Rev. App. Entom.*, **36**, Ser. A, 7, 1949, p. 234.) The author reviews recent literature on the use of chemicals for soil treatment against insects and other organisms injurious to crop plants. Those dealt with individually are 1,2-dichlorpropane (propylene dichloride), D-D mixture (1,2-dichlorpropane and 1,3-dichlorpropene with small amounts of other lighter and heavier saturated and unsaturated hydrocarbons), methyl bromide, ethylene dibromide, ethylene dichloride, benzene hexachloride, and DDT. He also reports that in preliminary tests in California he found technical chlordane to be very effective for the control of wireworms when used at the rate of 10 lb. per acre in 20 U.S. gals. of a solvent such as benzene. It was drilled into the soil to a depth of 6 inches at intervals of 12 inches.

Soil fumigants have often been observed to increase the growth and yield of a crop more than would be expected on the basis of the kill of insects given by them. The effect of different soil fumigants on the soil is not fully known, but a few of the reasons for crop stimulation following their use include the effect on the chemical and physical properties of the soil, particularly a change in soluble soil constituents, some effect on soil fertility, such as an increase in ammonia content, and an increase in the bacteria of the soil owing to the killing of harmful protozoa. In addition to the effects of partial sterilization, increased yields after the use of some volatile chemicals are due to the restoring of a more favourable biotic complex. The factors that determine the soil temperature, the type, composition, compactness and moisture content of the soil, the amount of fumigant used, adsorption, the correlation of time of treatment with the known behaviour of the organism to be killed, and the type of sealing used after treatment.

79. THE INFLUENCE OF MICRO-ORGANISMS ON CERTAIN PHYSICO-CHEMICAL PROPERTIES OF THE SOILS OF YANGAMBI. By H. Laudelout *et al.* (*Bull. Agric. Congo Belge*, **40**, 1, 1949, p. 339. From *Rev. App. Myc.*, xxviii, 9, 1949, p. 418.) In the course of a study of the influence of micro-organisms on certain physico-chemical properties of a yellow sandy soil under primitive forest near Yangambi, Belgian Congo, the authors found that at a depth of 0 to 10 cm., when the logarithm of the total number of organisms present was 6·287, the relative abundance of bacteria, actinomycetes, and fungi was respectively 35·7, 63, and 1·3 per cent. At lower depths to 120 cm. the logarithm gradually decreased, the number of fungi varying between nil and 0·6 per cent. and of actinomycetes between 34·2 and 74·5 per cent. In the upper layers of the soil, where they were most numerous, the actinomycetes were present as vegetative mycelium, whereas in the deeper layers they occurred mostly as chains of spores. Of the relatively few fungi, *Verticillium terrestre* and *Trichoderma glaucum* were the predominant species.

80. FERTILIZERS: WORLD PRODUCTION. (*Mthly. Rev. Wld. Sitn.*, Int. Cott. Adv. Cttee., September, 1949.) Although world commercial fertilizer production was well above pre-war levels in 1948-49, it was insufficient to meet requirements, and

supplies were under international allocations by the International Emergency Food Council of United Nations Food and Agriculture Organization. World supplies of nitrogen fertilizers for 1949-50 are, however, estimated at nearly 20 per cent. greater than in 1948-49, and international allocation has therefore been discontinued. Whilst there is no doubt that cotton yields could be considerably enhanced by the increased usage of fertilizers, the supply available for cotton cultivation is limited in many Eastern Hemisphere countries by insufficient foreign exchange for its purchase and the priority given to its use in food crops.

81. FERTILIZER MANUFACTURE IN EGYPT. By R. P. Dunn. (*Cotton in Egypt.*, Nat. Cott. Coun., U.S.A., 1949. Price 35c.) A fertilizer plant is being constructed at the lower end of the Suez Canal which will have a capacity estimated at 200,000 tons annually, and another is to be built shortly at the main dam in Asswan which is to have a capacity of 300,000 tons. In both cases, the product will be commercial calcium nitrate in chalk form with 16 per cent. available nitrogen. This quantity is approximately equal to the pre-war imports of commercial fertilizer of similar nitrogen content. However, pre-war applications of fertilizer were less than the recommended optimum. If and when this new domestic production is realized in cotton, as well as grain, it still will be necessary to import additional fertilizer in order to achieve maximum grain yields and to maintain production of cotton.

82. FERTILIZER MANUFACTURE IN UGANDA. See Abstract 42.

83. FERTILIZER PLACEMENT. By G. W. Cooke. (*World Crops*, **1**, 1, 1949, p. 32.) The efficiency of plant foods is influenced by their form and the way they are used. Fertilizer may be incorporated with the soil by spreading it on the surface before ploughing, or it may be spread after ploughing and worked into the soil while preparing the seedbed. A third way, which is referred to as fertilizer placement, is to restrict the fertilizer to bands in the soil near to the seed. This article summarizes the value of placement and describes the advantages which may be obtained from localized application of fertilizer.

STATISTICAL TREATMENT, CULTIVATION, GINNING, ETC.

84. THE IRRIGATION OF S×P COTTON ON CLAY LOAM SOILS IN THE SALT RIVER VALLEY. By K. Harris *et al.* (Agric. Expt. Sta., Tucson, Arizona, Bull. 210, 1947.) This report covers four years of work with differential irrigation schedules with S×P cotton on a clay loam soil located on the Mesa Experiment Station. The plants were grown on ⅛-acre field plots with three replications for each irrigation treatment.

The irrigation schedules were designed to determine the extent to which soil moisture supplies should be limited during the fruiting period and to ascertain the best time to change from abundant to limited soil moisture.

In general, the more rapid the growth prior to heavy fruiting, the higher were the final yields. Plants making slow growth prior to the fruiting period are stimulated into rapid growth after midsummer. This vegetativeness is detrimental to yield. Plants making rapid growth during April, May and June begin fruiting earlier and produce mature bolls earlier than plants retarded during early season. The reduced yields of plants retarded in early growth is probably due partially to the loss of the early crop, and partially to excessive plant growth during the fruiting period which reduces plant food supplies for the production of bolls. There were no significant differences between the yields of plants irrigated at 8 per cent. soil moisture after midsummer and those irrigated at 10 per cent. during this period.

85. IRRIGATION PROJECTS FOR THE COTTON-GROWING AREAS OF INDIA AND PAKISTAN. See Abstract 2.

86. IRRIGATION OF COTTON-GROWING AREAS IN MEXICO. See Abstract 71.

87. IRRIGATION OF COTTON LAND IN PERU. See Abstract 73.

88. EFFECT OF SUPERPHOSPHATE MANURES ON THE EGYPTIAN COTTON CROP. By D. S. Gracie and F. Khalil. (*Minist. Agric. Egypt, Tech. Sci. Serv.*, 1948, Chem. Sect. Bull., 251. From *J. Text. Inst.*, **40**, 8, 1949, p. A310.) In the course of

experiments on the effect of superphosphate on the main crops of Egypt, it was found that cotton responds significantly to superphosphate when the available P of the soil is less than 0·03 per cent. at any depth within the top 1 metre.

89. LIQUID COTTON DEFOLIANT. (*World Crops*, **1**, 2, 1949, p. 62.) A new "chemical Frost" that drops the leaves from cotton plants before harvest and thus permits mechanical pickers to do a faster and cleaner job has been tested recently. The new leaf-stripping agent, ammonium thiocyanate, is said to be the first defoliant that can be applied in liquid form.

90. WEED CONTROL WITH METHOXONE AND CHLOROXONE. (*Ann. Rpt. Dept. Agr., Sudan*, 1948-49.) An experiment was carried out to see if Methoxone and Chloroxone sprayed early in June would prevent the germination in the early rains of cotton seed unintentionally left on the land from the previous season. This would be useful as a measure of blackarm control. The germination was heavily reduced, though not sufficiently for the purpose. Weed cover was reduced, but only one species was significantly affected. Cotton was sown on the land in mid-August, and germination and yield were unaffected by the weed killers.

91. MACHINERY FOR LAND CLEARANCE AND INITIAL CULTIVATION. By P. H. Southwell. (*World Crops*, **1**, 3, 1949, p. 107.) Mechanical methods of clearing land and preparing it for cultivation have attracted much attention of late years, and the bulldozer, the stump-extractor and similar mechanical devices have been applied on an ever-increasing scale to land clearance in agriculture. Recent rises in labour costs and shortages of manpower, combined with the need for rapidly expanding production of food and raw materials in undeveloped regions, particularly in the tropics, have further increased the urgency of the need for finding more rapid and less expensive methods of performing these operations, which have always been among the most arduous of those with which the cultivator is faced. In this article the most important devices at present available for the mechanical clearance of land are reviewed and described.

COTTONSEED AND COTTONSEED PRODUCTS

92. NATION-WIDE RESULTS WITH FUNGICIDES IN 1948. FOURTH ANNUAL REPORT. (*Plant Dis. Reptr.*, Suppl. 181, 1949, p. 17. From *Rev. App. Mycol.*, xxviii, 9, 1949, p. 471.) Following experiments conducted in 1948 in the United States, Canada and Mexico, the Fungicide Committee of the American Phytopathological Society gives in this report a general appraisal of fungicides for seed treatment. Those recommended for the treatment of cotton seed are Ceresan M and Dow 9-B. Seedox was found promising, but requires more testing.

93. RELATION OF MOULDS IN MOIST STORED COTTON SEED TO INCREASED PRODUCTION OF CARBON DIOXIDE, FATTY ACIDS AND HEAT. By C. M. Christensen *et al.* (*Cereal Chem.*, **27**, 2, 1949, p. 109. From *Rev. App. Mycol.*, xxviii, 9, 1949, p. 276.) During the past twenty years considerable evidence has accumulated to indicate that moulds are often a major factor in the spoilage and heating of moist stored seeds of various kinds. Whether cotton seed is included in this category has been questioned, although it is known to harbour a fairly rich internal flora of both saprophytic and parasitic species, and the present work was accordingly undertaken to explore some aspects of the problem.

The mould population increased rapidly on and within seed (mostly un-delinted Stoneville) stored at relative humidities of 84 to 90 per cent. for ten days at 30° C., and in general, carbon dioxide and free fatty acid production rose at the same time. The peculiar structure of the seed coat enables the moulds to gain easy access, through a pore-like aperture filled only with thin-walled parenchyma cells, to the interior of moist stored cotton seed, where they grow vigorously and sporulate profusely without betraying their presence by any external symptoms. Fungicides applied to the outside of the seed did not prevent rapid mould growth and sporulation in the interior; entire kernels and hulls stored moist without a fungicide respired more quickly, had a higher fatty acid content, and bore a larger mould population than similar fractions treated with thiourea. The results of these experiments suggest that moulds, including *Penicillium* sp., *Aspergillus glaucus*, *A. ochraceus*, *A. candidus*, *A. versicolor*, *Glomerella gossypii*, and *Fusarium vasinfectum*, may play an important part in the deterioration of moist stored cotton seed.

94. COTTONSEED PENTOSAN CONCENTRATE: PREPARATION. By H. E. Shiver. (*Ind. Eng. Chem.*, **41**, 1949, p. 978. From *Summ. Curr. Lit.*, xxix, 18, 1949, p. 350.) An illustrated account is given of the preparation of pentosans from cottonseed hulls, which have the highest pentosan content of any known plant material. The structure of the hulls is such that the pentosans may be concentrated by milling and screening. Pilot-scale and large-scale milling are discussed and experimental data are presented. The lint obtained as a by-product is relatively clean.

95. COTTONSEED FIBRES. By G. E. Hilbert. (*Textile Age*, **13**, July, 1949, p. 100. From *Text. Tech. Dgst.*, **6**, 9, 1949, p. 671.) Two new synthetic fibres are reported. One is made from cottonseed protein, is yellow or light orange, is about three-quarters as strong as wool when dry, feels soft to the hand, and has good dyeing characteristics. The other fibre is spun from sodium carboxymethyl cellulose and salts of certain metals. It is colourless or lightly tinted, will dissolve in weak alkali solutions, has a dry strength about equal to that of wool and is useful as a scaffolding fibre. Methods of spinning these new fibres are similar to the extrusion or spinneret system in making synthetic textiles.

96. COTTONSEED CROP: SÃO PAULO. (*World Crops*, **1**, 4, 1949, p. 182.) The present cotton crop from the State of São Paulo should yield 360,804,813 kg. of cottonseed, of which 24,000,000 kg. would be put aside for planting, leaving 336,804,813 kg. to be milled for the extraction of edible cottonseed oil, excepting the oil produced from about 15,000,000 kg. of seed, which would not be fit for consumption. Based on the amount of seed already delivered to the oil refineries and still to be delivered, it is estimated that the total cotton crop will yield 28,396,162 kg. of cottonseed oil. It is calculated that this will be insufficient for domestic necessities, and there will be no surplus for export.

PESTS, DISEASES AND INJURIES, AND THEIR CONTROL

97. TOXICOLOGY OF THE NEWER AGRICULTURAL CHEMICALS. By A. J. Lehman. (*Pyrethrum Post*, **1**, 4, 1949, p. 27.) In the development of insecticides the fundamental purpose is to determine the effectiveness of the poison under given conditions and the best method of application. Insect toxicology is usually concerned with the smallest amount of the poison which will kill all individuals. This is in contrast with the broader aspects of the problem which are concerned with the pharmacological effects of the poison in animals and man and deal with the largest amount which will not produce injury. This latter phase is discussed in this article and an attempt is made to appraise the present status of the newer as well as some of the older agricultural chemicals.

98. COTTON INSECTS: CONTROL BY INSECTICIDES. (*Conference Report on Cotton Insect Research and Control, Baton Rouge, Louisiana*, Nov. 8-10, 1948. Bur. Ent. and Plant Quar., Agr. Res. Admin. U.S.D.A.) This is a summary report of the Conference of Federal and State workers concerned with cotton insect research and control. It brings together the results of recent research and experience. While it is emphasized that control of cotton insects by the use of insecticides is supplemental to the adoption of good farm practices, cultural methods of controlling cotton pests are not considered in this report, except for the pink bollworm. In addition to recommendations for the use of certain insecticides, it contains some suggestions as to research needs in developing a more effective cotton insect control programme.

99. COMBINED CHEMICAL AND BIOLOGICAL CONTROL OF INSECTS BY MEANS OF A SYSTEMIC INSECTICIDE. By W. E. Ripper *et al.* (*Nature*, 21/5/49, p. 787.) Systemic insecticides have been defined as insecticides which are carried in the sap-stream of plants and thus make such plants poisonous to insects, even in parts of the plant which are not reached by the spray. The three groups of insecticides with outstanding systemic action are selenium compounds, organic fluorine compounds and organic phosphorus compounds. Selenium compounds are so toxic to man that their use as insecticides is out of the question, and our present-day knowledge of the fluorine-containing compounds is, perhaps, too incomplete to permit their use with safety on food crops. Attention was therefore focused on less dangerous and therefore more useful organic phosphorus compounds which show considerable systemic effects, but are not more toxic than many previously used insecticides. A systemic action can be demonstrated either by placing the leaves or twigs bearing feeding aphides in a solution of the chemical, or by spraying it on leaves to give only a partial cover. A wide range of insects have been shown to be killed by the systemic action of the phosphorus compound in question, and the results show that it is especially effective against aphides and certain related Homoptera, and is selective in that it is relatively non-toxic to beneficial insects.

The compound can enter the plant through the stomata, the cuticle of the leaves, the roots and the cut stems, and the chemical then travels within the plant, where it seems to be translocated to growing parts. While a great deal of work on this compound remains to be done, sufficient progress has been made to establish that it is an effective systemic and selective insecticide.

100. SUPPRESSION OF INSECT DAMAGE BY MEANS OF PLANT HORMONES. By T. C. Allen. (*J. Econ. Ent.*, **40**, 6, 1947, p. 814. From *Rev. App. Entom.*, **37**, Ser. A, 8, 1949, p. 287.) The author discusses, largely from the literature, the similarities that have been observed between the changes in plant growth caused by insect feeding and those induced by applications of plant hormones. Similar enzyme activities are apparently involved, and it may prove possible to explain the effects of the toxins sometimes injected by insects during feeding on a basis of growth-regulating factors. It has been found that the application of hormones to bean plants prevents blossom and pod drop due to *Lygus* feeding in the United States and that certain insecticides, particularly DDT, may possess hormone-like qualities and cause increases in plant growth. It would be of considerable importance in insect control if chemicals could be found that would not only kill insects but also inhibit plant damage caused by them and improve the quality of the plant itself.

101. LABORATORY EXPERIMENTS ON THE EFFECT OF DDT AND BHC ON CERTAIN APHIDOPHAGOUS INSECTS AND THEIR HOSTS. By M. J. Way. (*Bull. Entom. Res.*, **40**, 2, 1949, p. 279.) In the field in any one year many factors are involved in the host-predator-insecticide relationship: abundance of host, abundance of various species of parasite and predator, nature and mode of preparation and time of application of insecticide, type of crop, and general climatic conditions, to mention only a few. Clearly the evidence that insecticides such as DDT encourage development of pests by destruction of their parasites and predators, although proven in the case of red spider, requires to be substantiated by long-term observations on insect populations in the field. Massee and Hough have made important observations that although beneficial insects were destroyed following application of DDT in the field, their numbers increased rapidly when treatment was discontinued, but whether widespread and long-term use of insecticides is liable to deplete parasite populations permanently is not known. The problem is important in view of the development of resistant strains of insect pests and their artificial selection by insecticides. Entomophagous insects, if present, may play an important part in the destruction of such resistant individuals whenever they appear in the pest population.

102. *Anthonomus vestitus* AND ITS NATURAL ENEMIES IN PERU, AND THEIR IMPORTATION INTO THE UNITED STATES. By P. A. Berry. (*J. Econ. Ent.*, **40**, 6, 1947, p. 801. From *Rev. App. Entom.*, **37**, Ser. A, 8, 1949, p. 286.) *Anthonomus vestitus*, Boh., a major pest of cotton in Peru, is attacked there by three important parasites, *Catolaccus townsendi*, Crwf., *Triapis vestiticida*, Vier., and *Bracon* (*Microbracon*) *vestiticida*, Vier. The last two of these were sent to the United States and liberated against *A. grandis*, Boh., on cotton in 1941-45, but *C. townsendi* was already known as a parasite of *A. grandis* in the United States, where it has been recorded as *C. hunteri*, Crwf. Both introduced species attacked *A. grandis* and have been recovered from this weevil in the area in which liberations were made, but are not known to have become established.

In the course of collecting and rearing these parasites, numerous data were accumulated on *A. vestitus* and its natural enemies in Peru. It feeds on the tender terminal shoots and squares of cotton; the adults fly well and are apparently able to disperse rapidly. The larvæ develop entirely within the squares and as many as 5 may be present in each. The larval and pupal stages and complete development last 8-14, 5-12 and 16-30 days respectively, and there are 4-6 generations a year. Infestation increases rapidly between March and July in northern Peru and reaches its peak in February or March in the south, where ratoon cotton is cultivated. Adults of *B. vestiticida* hover round the cotton squares and are most active from 1.30 a.m. to noon and fairly active from 3 to 6 p.m. on bright days and most active from 11 a.m. to 2 p.m. on cloudy ones.

The eggs are deposited singly on the larvæ of *A. vestitus* within the squares and hatch in 2-3 days. The larvæ feed for 4-5 days, and complete development required 2-3 weeks during May and June. The percentage parasitism of *A. vestitus* by *B. vestiticida* in the Canete Valley in 1941 was 10·5 on May 12 and 25 on July 5. The eggs of *T. vestiticida* are deposited in the eggs of *A. vestitus* and possibly also in the young larvæ. The parasite larva develops within the host larva for a time, but apparently feeds externally for a short period before spinning its cocoon within the square. Development lasts 2-3 weeks in northern Peru during July and August. Parasitism by *T. vestiticida* is usually low during the first part of the season and does not increase noticeably until the host population becomes rather dense, but from the end of June to the end of September it increases rapidly and reaches a high figure; under favourable conditions in one locality it reached 89·2 per cent. *T. vestiticida* was found in large numbers only in northern Peru. The eggs of *C. townsendi* are deposited externally on the larvæ of *A. vestitus* and the larvæ feed externally, 1-3 or more developing on the same host. They pupate within the cotton bud, and complete development lasts 2-3 weeks.

Eupelmus cushmani, Crwf., appeared in small number in the rearing cages and was probably parasitic on *A. vestitus*, but was so infrequent as to be ineffective. Several samples of infested squares were exposed to females for 5-7 days, but no oviposition was noted and no parasites of this species resulted. Another species of *Eupelmus*, *Eurytoma tylodermatis*, Ashm., and an unknown species of *Eurytoma* also appeared in the rearing cages, but were not proved to attack *A. vestitus*. *Pediculoides ventricosus*, Newp., was observed many times and is said to be effective against *A. vestitus*, sometimes killing 20 per cent. of the larvæ, pupæ and adults.

103. SOME INSECTICIDES CAUSING BOLL WEEVIL MORTALITY INSIDE PUNCTURED COTTON SQUARES. By C. F. Rainwater. (*J. Econ. Ent.*, **40**, 6, 1947, p. 923. From *Rev. App. Entom.*, **36**, Ser. A, 8, 1949, p. 303.) In the course of field experiments in which several insecticides were applied as dusts against *Anthonomus grandis*, Boh., on cotton during the summer of 1947, infestation was kept at a low level in some of the plots in a way that suggested a possible ovicidal or larvicidal action of some of the insecticides, and 200 fallen squares in which eggs had been deposited were therefore collected on July 22, shortly after the fifth application, from six plots that had received different treatments, and kept in the cages until emergence of adults was apparently complete. Emergence began on July 31, and the numbers of weevils emerging after the different treatments were 102 for calcium arsenate, 12 for BHC (benzene hexachloride) diluted to 6 per cent. γ isomer, 42 for a mixture containing 3 per cent. γ BHC and 5 per cent. DDT, 83 for 20 per cent. chlorinated camphene (toxaphene), 0 for 20 per cent. chlordane, and 117 for 2 per cent. 0,0-diethyl 0-paranitrophenyl thiophosphate (parathion).

Examination of the squares treated with chlordane showed that development within them was apparently normal to the adult stage, but that the adults were either dead or paralysed. Squares treated with the other insecticides were not examined. During the remainder of the season, eight other series of punctured squares were collected at different times from plots treated with the same insecticides at various strengths, and records were kept of emerging adults, living and dead adults in squares, dead larvæ and pupæ in squares and dead adults in the cages. The dead larvæ and pupæ were ignored, however, in estimating the effects of the treatment, as they were not numerous and might have died from natural causes. In general, the results indicated comparatively little mortality of *A. grandis* within punctured squares when calcium arsenate, 50 per cent. DDT in alternate application, or 1-5 per cent. parathion was applied to cotton in the field. Average mortality was 36 per cent. in the plot treated with 20 per cent. toxaphene, but only 16 per cent. in that treated with 10 per cent. toxaphene. The samples of BHC used, alone and with DDT, were from different sources and had different properties and caused widely different mortalities; these ranged from 76 to 24 per cent. and did not vary regularly with the γ isomer content of the dusts. Chlordane was the most effective compound tested against *A. grandis* within the bolls, and dusts containing 10 and 20 per cent. caused 84 and 92 per cent. mortality, and those containing 5 per cent. with 5 per cent. DDT or toxaphene, 82 and 75 per cent.

104. TESTS OF INSECTICIDES FOR CONTROL OF GRASSHOPPERS. By J. C. Gaines. (*J. Econ. Ent.*, **40**, 6, 1947, p. 896. From *Rev. App. Entom.*, **37**, Ser. A, 8, 1949, p. 297.) The results are given of laboratory and field tests carried out near College Station, Texas, in the spring of 1947 in an attempt to develop more effective and economical methods of controlling grasshoppers in this area. Mixed populations of grasshoppers were found, but the majority were *Melanoplus differentialis*, Thos. Hatching was considered to be complete by May 5, when the first field tests was begun. Nymphs that had not reached the fifth instar were used in all tests. When they were caged with cotton plants that had been dusted with different insecticides an hour before, 10 per cent. chlordane gave higher mortality than 3 per cent. γ benzene hexachloride, alone or with 5 per cent. DDT, or than 10 per cent. toxaphene or 1 per cent. aryl alkyl thionophosphate. Although the nymphs came in contact with the materials, it is assumed that these acted principally as stomach poisons. When the nymphs were dusted and put in cages containing clean cotton plants, to test the contact effect of the insecticides, 3 per cent γ benzene hexachloride was much the most effective, and 10 per cent. chlordane and 1 per cent. aryl alkyl thionophosphate were more toxic than 15 per cent. toxaphene.

Considerable areas of weed fields, hedgerows and edges of lucerne and cotton fields were dusted with toxaphene and benzene hexachloride by aeroplane or ground machinery. The treatments were effective and prevented damage to cultivated crops. When the grasshopper populations were high, 1·5-2 lb. toxaphene or 0·3 lb. γ benzene hexachloride per acre was necessary for adequate control. The effectiveness of benzene hexachloride was greatly reduced by wind drift.

105. *Laphygma exigua*, CONTROL BY DDT. By J. N. Roney. (*J. Econ. Entom.*, **40**, 6, 1947, p. 931. From *Rev. App. Entom.*, **36**, Ser. A, 8, 1949, p. 304.) In Arizona, *Laphygma exigua*, Hb., is often present on cotton and lucerne, but is rarely injurious, because the first generation is usually practically destroyed by parasites or predators. In 1946 a heavy outbreak occurred on cotton seedlings in Pinal County, but it was controlled with one application of a 5 per cent. DDT dust at 20 lb. per acre. In February, 1947, larvæ of *L. exigua* were numerous on flowering flax in Yuma County and were feeding on the upper portions of the plants and destroying the fruiting parts, and the same DDT dust was therefore applied at 20 lb. per acre when weather conditions allowed. As the flax was so far advanced, dusting from an aeroplane was the only practical method of application, and one treatment gave complete control of the insects and saved the crop. *L. exigua* was also present on flax in the Imperial valley of California and was controlled in the same manner.

106. LOCUST CONTROL. (*Corona*, **1**, 10, 1949, p. 6.) The first meeting of the International Red Locust Control Council was held at Abercorn in Northern

Rhodesia at the end of September. It was attended by delegates from the East and Central African territories, the Belgian Congo and the Union of South Africa. Dr. Uvarov unveiled the foundation stone of the new laboratory, which is being built in Abercorn from funds contributed by the territories represented on the Council.

107. AIRCRAFT SPRAYING AGAINST THE DESERT LOCUST (*Schistocerca gregaria*, Forskal) IN KENYA, 1945. By D. L. Gunn *et al.* (Anti-Locust Res. Centre, Bull. 4, 1948. Price 12s.) Air-to-ground spraying against settled locusts may be capable of development into a general control method, especially if suitable helicopters can be used for swarm reconnaissance and delimitation. When reliable weight-carrying and long-endurance helicopters capable of operating over high ground become available, the possibilities of correlated development should be examined. Curtain spraying against flying swarms is a promising method and should be the subject of immediate further researches; it promises economical protection of one region from invasion from another, utilizing to the full the advantages of fixed-wing aircraft.

108. FIELD OBSERVATIONS ON LOCUSTS IN EASTERN AFRICA. By H. B. Johnston and D. R. Buxton. (Anti-Locust Res. Centre, Bull. 5, 1949. Price 8s.) The primary objective of the investigations was to establish the presence, or absence, of outbreak areas of the African Migratory Locust (*Locusta migratoria migratorioides*, R. and F.) in Eastern Africa, and to study the process of disintegration of swarms of this species and the transformation of its dangerous swarming phase (ph. *gregaria*) into the harmless solitary phase (ph. *solitaria*).

The occurrence at the same time in Eastern Africa of the Red Locust (*Nomadacris septemfasciata*, Serv.) offered an opportunity for some observations on this species as well, while some investigations were also made in certain areas which were suspected as possible outbreak areas of the Desert Locust (*Schistocerca gregaria*, Forsk.).

The investigations carried out in Uganda, Kenya and southern Somalia supplied reliable evidence in favour of the view that these countries do not harbour outbreak centres of any of the three locust species which are known to invade Eastern Africa. This conclusion, while purely negative, is most reassuring. On the other hand, the results of the present investigations, coupled with those carried out in other parts of the continent, leave no doubt that Eastern Africa will continue to be subject to locust invasions from outside, unless measures are taken to prevent swarms arising in the outbreak areas. Such measures are to be regarded as essential for the protection of planned development of Eastern Africa.

109. LOCUST DESTRUCTION IN SOUTH AFRICA. (*World Crops*, **1**, 3, 1949, p. 129.) The recent seasonal review of locust destruction in South Africa disclosed that conditions were exceptionally favourable for the rapid increase of locusts in general, and as a result, extensive campaigns were conducted in 26 districts against incipient outbreaks of the brown locust, while swarms of the desert locusts had to be destroyed in two districts. In the swampy areas of the Bechuanaland Protectorate, the tropical migratory locust increased to critical densities. The International Red Locust Control Service conducted campaigns inside as well as outside the known outbreak areas of the red locust in Central Africa. In all these destruction campaigns a great measure of success was attained, and it can be stated that agriculture suffered no losses as a result of locust ravages.

110. PINK BOLLWORM; TESTS WITH DDT, BENZENE HEXACHLORIDE AND RYANIA FOR THE CONTROL OF. By O. T. Robertson. (*J. Econ. Ent.*, **41**, 1, 1948, p. 120. From *Rev. App. Entom.*, **36**, Ser. A, 9, 1949, p. 354.) Field-plot and field-cage tests of insecticides against *Platyedra* (*Pectinophora*) *gossypiella*, Saund., on cotton were carried out at Presido, Texas, in 1946. In small-plot tests in which dusts of 5, 10 and 20 per cent. technical DDT in pyrophyllite were applied at various rates five times at weekly intervals, the control of green-boll infestation was directly proportional to the total amount of DDT applied per acre and ranged from 9 and 12 per cent. with 3·8 lb. per acre to 57 per cent. with 17·5 lb. In additional tests, 10 per cent. DDT in pyrophyllite gave somewhat better control than 1·43, 2·87 and 5·75 per cent. γ benzene hexachloride in sulphur or 50 per cent. *Ryania* powder in sulphur.

In tests under a field cage covering 0·55 acre and partitioned into three equal sections, there was no significant difference in the control obtained with the 10 per cent. DDT dust applied at 26·3 lb. per acre per application and a solution of technical DDT in xylene emulsified with water and applied with a hand sprayer at the rate of about 10 U.S. gals. spray (2·69 lb. technical DDT) per acre per application. Both treatments were made 11 times at weekly intervals from June 4, six days before the first bloom, until August 12, when green bolls became scarce. The average percentages of the blooms and bolls infested and the yields of seed cotton per acre were respectively 3, 7, and 1,249 lb. in the dusted section, 4, 5 and 1,274 lb. in the sprayed section, and 38, 100 and 351 lb. in the untreated section. The application of about 29 lb. DDT per acre during the season thus prevented any damage, but since the deposit was probably more effective under the cage than it would be in the field owing to shade, and the partitions prevented moth migration into the treated areas, control was probably considerably higher than would be possible under field conditions.

When plants were dusted with 10 per cent. DDT in pyrophyllite at the rate of about 20 lb. per acre and immediately caged with 50 pairs of moths per cage, oviposition was reduced by 88 per cent., whereas when 50 pairs of moths were caged on plants for four days, after which the cages were removed (before any of the eggs had hatched) and the plants were treated with the same dust at the same rate, there was a reduction of only 8 per cent. in the number of larvæ per boll 12 days after treatment, indicating that the control from DDT dust is due to moth mortality rather than to the mortality of newly hatched larvæ.

111. COTTON SEED DISINFECTION AS A SUPPLEMENTARY CONTROL MEASURE FOR PINK BOLLWORM (*Platyedra gossypiella*, Saund.) IN MOZAMBIQUE. By J. E. Baptista. (*J. Ent. Soc. Sthn. Afr.*, **9**, 2, 1947, p. 111. From *Rev. App. Entom.*, **37**, 7, 1949, p. 264.) *Platyedra gossypiella*, Saund., is widely distributed on cotton in Mozambique, and one of the control measures adopted was treatment of the seed to destroy the long-cycle larvæ, though it was not known that they occur there. After no larvæ had been observed in seed from areas that had been infested for a considerable time, 186 samples of cotton seed of different grades from the most important cotton areas, comprising in all about a million seeds, were collected in the gins in 1944 and 1945. One small portion from each, comprising some 250 seeds selected at random, was examined to determine the rate of infestation; another, consisting of bored seeds and seeds suspected of being infested, was examined microscopically, and the remainder was kept under observation for the emergence of moths. No moths emerged, and no infestation was noted by the first method of examination, but microscopic examination revealed the presence of insect remains representing an estimated infestation of 0·4 per cent. in eight samples. Fragments of larvæ found in one sample and the remains of a pupa in another might have represented insects that had died during the period between collection and examination, which in general was long. Living larvæ and pupæ possibly occur in the seeds before ginning, and seeds ginned immediately after harvest might therefore contain living insects.

The diapause of the larvæ is induced by a change in nutrition from green bolls, which they prefer, to ripe ones. Since some green bolls are always present in Mozambique, and since infestation there is not very heavy, the disinfestation of seed destined for areas where *P. gossypiella* is known to occur is not considered justifiable.

112. THE STIMULANT INVOLVED IN THE GERMINATION OF *Striga hermonthica*. By R. Brown *et al.* (*Procdgs. Roy. Soc.*, **136**, B, 1949, p. 1.) The seeds of *Striga hermonthica* will only germinate readily when they have been exposed to a chemical stimulant released from a potential host root, and the purpose of this investigation has been the examination of the chemical nature of the stimulant.

Crude concentrates have been prepared by growing roots of intact seedlings of *Sorghum vulgare* in water to which charcoal has been added, removing the charcoal and then eluting it with 70 per cent. acetone. A residue is obtained which when redissolved in water promotes the germination of the parasite seed. It has been shown that the concentrate contains carbohydrates and particularly pentoses, although aldopentoses appear to be absent. At the same time the effects on germination of a large variety of sugars has been tested and, a relatively weak effect has been observed with certain samples of seed with D-fructose-1 : 6-diphosphate and with 1-sorbose. The most powerful stimulation, however, has been given by D-xyloketose. This carbohydrate has given germination with all samples of seed with which it has been tested and at concentrations lower than with the crude concentrate. Maximum germination has been recorded with D-xyloketose at a concentration of 1×10^{-6} mg./ml. and some stimulation at 1×10^{-7} mg./ml.

Fresh preparations of the concentrate and of D-xyloketose are also similar in the important respects that when stored at 5 to 15° C. the activities of both disappear completely within 72 hr., and that they are both completely inactivated by heating at 60° C. for 60 minutes. Thus it is highly probable that the stimulating action of the crude concentrate is due to a substance which is either similar to or identical with D-xyloketose.

113. Effect of the *Striga* Germination Stimulant on the Respiration of *Striga* Seeds. By K. B. Vallance. (*Nature*, 5/11/49, p. 802.) It is reported that when air-dry seeds of *Striga hermonthica* were treated with a solution of the stimulating substance, subsequent germination under optimum conditions was almost completely inhibited. The nature of this inhibition has not yet been fully established, but several replicated experiments have shown that the stimulating solution has a marked effect on the respiration of *Striga* seeds. This increase in the rate of respiration takes place at the expense of the sugar reserves of the seeds.

Respiration of the seeds of *Striga hermonthica* is also enhanced by the stimulating solution when the seeds are able to germinate. An experiment was carried in which 50 per cent. of the seeds were induced to germinate after 6 days of moisture treatment at 22° C., followed by exposure to the stimulating solution for 48 hours at 32° C. Studies on the respiration of the seeds during the first 12 hours of exposure to the stimulating solution, together with chemical analysis, showed that in this case the substrate for respiration is protein, and that there is no decrease in the rate of respiration after 12 hours. Subsequent experiments have shown that the stimulating solution increases the rate of respiration of *Striga* seeds when they are treated with it after prior exposure to moisture for various times at various temperatures.

(*Cf.* Abstract 466, Vol. XXVI of this Review.)

114. A Combined Hand- or Power-operated Sprayer for Fly and Mosquito Control. By A. E. H. Higgins and A. A. Green. (*Anns. of Appd. Biol.*, **36**, 3, 1949, p. 383.) A new sprayer is described which was designed in 1945 for the control of adult flies and mosquitoes with insecticides having a kerosene base. This sprayer has been shown in laboratory tests against houseflies and yellow fever mosquitoes to be highly efficient for both kill and knock-down, and to achieve a particularly rapid knock-down for mosquitoes.

The sprayer can be operated with a hand pump or connected to a supply of compressed air. Air consumption is very low, and when the sprayer is power-operated optimum biological efficiency is obtained at 20 lb. per square inch air pressure. There is no spitting or dribbling from the nozzle, and the mist does not settle so rapidly as to cause any appreciable staining of the floor. Although robust it is light, easily manipulated and can be dismantled into component parts for cleaning. It has no adjustments; but the nozzle, which must be machined with precision, is automatically set in its most effective spraying position when screwed home tightly.

115. A Vertical Spraying Apparatus for the Laboratory Evaluation of all Types of Liquid Pest Control Materials. By J. G. ten Houten and M. Kraak. (*Anns. of Appd. Biol.*, **36**, 3, 1949, p. 394.) Following a discussion of methods for the uniform application of insecticides for evaluation purposes, a description of a vertical spraying apparatus is given. The spraying procedure is described. By varying different factors and estimating the consequent variation in the replication of deposit, the accuracy of the apparatus was determined. The main advantage of the present method lies in the possibility of accurate and quick readjustment of the nozzle by means of a calibrated adjusting nut and a fixed vertical pointer. The nozzle is constructed of stainless metals and is not easily damaged.

116. Breeding for Resistance to Bacterial Blight of Cotton. By L. M. Blank. (*Phytopathology*, 39, 6, 1949, p. 494. From *Rev. App. Mycol.*, xxviii, 11, 1949, p. 573.) The Stoneville 20 strain of cotton has been used as the blight (*Xanthomonas malvacearum*) resistant parent in a number of crosses with susceptible varieties and breeding strains of cotton. The resultant progenies were carried through the F_3 generation or back-crossed twice to the recurrent susceptible variety or strain, selfed, and tested for reaction to the disease. Inoculation of the breeding material in field plantings was effected by spraying the lower leaf surfaces of five- to eight-week-old plants with a suspension of the organism, and grading for disease reaction was made 15 to 20 days later. The lesions of resistant phenotypes are fewer and smaller than those of susceptible ones. F_1 offspring of the susceptible cross were susceptible, while the F_2 progenies segregated at a ratio approximating 3 : 1 for susceptibility and resistance. The approximation was closest in crosses involving highly susceptible varieties like Acala and less so in those with considerable natural tolerance. Progenies derived from selfing after one and two back-crosses yielded populations pure for susceptibility or segregating, the latter consisting of susceptible and resistance plants in a 3:1 ratio. These data indicate that the Stoneville 20 type of resistance to blackarm is inherited as a single factor, with resistance recessive to susceptibility.

117. Bacterial Blight on Cotton in Madras. By R. Balasubrahmanyan and A. Raghaven. (*Cott. Pests and Dis. Pap.*, Indian Cent. Cott. Comm., 4, 1949. From *Rev. App. Mycol.*, xxviii, 11, 1949, p. 572.) In India incidence of cotton blackarm (*Xanthomonas malvacearum*) is confined to parts of Madras where the eco-climatic conditions normally favour its development. In 1945 the crop in most of the areas receiving intermittent heavy rains developed heavy infection with considerable resultant reduction in total production. Severe incidence and losses occurred where the new strain Co3 (Co2+Uganda 4/4) was grown on both irrigated and unirrigated areas. Breeding for resistance had to be included in the breeding programme.

The first two years' work (using the secondary infection method) proved that (*a*) Madras American cotton differed in resistance; (*b*) among the cultivated strains pure line selection 920 and the hybrid strain Co3 were the most susceptible, followed in order by Co2 (a pure line) and 4463 (Co2+Uganda 4/4), while the most resistant was Co4 (Co2+A 12); (*c*) all except Co4 failed to respond to re-selection; and (*d*) it was found possible to develop a resistant secondary selection Co4/B40-21 and to build up a high resistance in the derivatives of hybrids from resistant parents. Corroborative evidence of the resistance of Co4/B40-21 was obtained from growers in a year of optimum environmental conditions for large-scale secondary infection, when the local variety suffered from both leaf fall and stem attack, though the new substrain showed only mild leaf spot. The secondary infection method was also helpful in grading progeny derived from crosses with susceptible parents such as Co3, and was indispensable in eliminating weak biotypes in the early stages.

Experimental evidence supported the view that differential biological races of the organism do exist and that the Indian races can break the resistance of B_2B_3 types singly or severally unless strengthened by the addition of major or minor genes from the acclimatized Madras Uplands. Uganda B31 tested under conditions of natural field infection behaved similarly and reached a grade of susceptibility equal to Co3, but the resistance of BAR 2-7 was on a par with Co4/B40-21. This difference is not explicable except on the assumption that BAR types differ in a major or minor genic complex, this becoming apparent only under Indian conditions and upon impact with new races of the organism.

118. Breeding for Resistance to Fusarium and Verticillium Wilts. By C. D. Sherbakoff. (*Bot. Rev.*, **15**, 6, 1949, p. 377. From *Rev. App. Mycol.*, xxviii, 10, 1949, p. 532.) After briefly referring to the general features of the wilt-inducing species of *Fusarium* and *Verticillium* and the diseases they cause, the author traces from the literature the progress made up to the present day in breeding for resistance to the wilt disease of a number of economic hosts.

119. Hypodermic Injection as a Method of inoculating Cotton Plants with *Verticillium albo-atrum*. By L. A. Brinkerhoff. (*Phytopathology*, **39**, 6, 1949, p. 495. From *Rev. App. Mycol.*, xxviii, 11, 1949, p. 573.) In California and Arizona it is rare for more than 15 to 30 per cent. of a susceptible cotton population to show symptoms of *Verticillium* wilt (*V. albo-atrum*) at the opening of the selfing season, in either naturally or artificially infested soil. Thus, in breeding for resistance to the disease much time may be lost in selfing plants that subsequently prove susceptible. Hypodermic injection and wound inoculation both produced high percentages of infection in young field-grown plants in 1947 and 1948, but the former method was much the more rapid, being about equal to soil infestation in this respect. A veterinary syringe with a No. 24 needle was used to inject about ¼ ml. inoculum just below soil-level into the hypocotyl of seedlings with two or four true leaves. Within three weeks symptoms developed on 99 per cent. of the plants of the susceptible variety Acala 1-23-11, and 98 per cent. on those of the tolerant Missdel + Acala 10-13, the latter suffering much less severely than the former and comprising a far higher percentage of recoveries.

120. *Pseudomonas malvacearum*. By M. Hekimi. (*J. Plant Prot.*, **2**, 7, 1949, p. 161. From *Rev. App. Mycol.*, xxviii, 10, 1949, p. 523.) Angular leaf spot of cotton caused by *Pseudomonas* (*Xanthomonas*) *malvacearum* was first observed in Turkey in 1936. It was reported from western Anatolia this year, but was not serious owing to the dry weather.

121. Instructions for the Recognition of Cotton "Ramulosis." By J. Abrahão and A. S. Costa. (*Biológico*, **15**, 3, 1949, p. 59. From *Rev. App. Mycol.*, xxviii, 11, 1949, p. 574.) A description is given of the symptoms of cotton "ramulosis," an extreme form of anthracnose caused by *Colletotrichum gossypii* var. *cephalosporioides*, which has now been reported from Pernambuco, Parahyba, Rio Grande do Norte, and Pará, as well as from São Paulo, Brazil, causing reductions in yield ranging from 30 to 70 per cent. A number of commercial varieties with adequate resistance to ramulosis are at present available.

122. The Plant in Health and Disease. By W. A. R. Dillon Weston and R. Eric Taylor. (London: Crosby, Lockwood and Son, Ltd., 1948. Price 21s. From *Anns. of Appd. Biol.*, **36**, 3, 1949, p. 406.) This book will be of interest and value to the student, the advisory officer and the farmer or grower. The student will find it a good introduction to the basic principles of what constitutes health and disease in plants, and to the main groups of plant disease and their causative organisms. The advisory officer will find that it explains well the methods of practical plant pathology; and the farmer and grower will find in it a readable account of many of his own particular troubles, combined with much sound advice.

The account is a good summary of the whole field of Plant Pathology. The chapters deal briefly with ancient and modern views on plant disease, the green plant in relation to its environment, the biology of fungi and spore dispersal, classification of disease organisms, symptomatology, principles of plant protection, modern methods of seed treatment, selected diseases carried by seed and soil, some tomato diseases, diseases spread by airborne spores, nutritional troubles and virus diseases. Finally, there are two useful chapters on legislation and technical advice. An appendix gives a list of common plant diseases and their causes. The illustrations are excellent and many of them are original.

123. Lines of Approach to the Control of Plant Diseases. By J. B. Marchionatto. (*Rev. Argent. Agron.*, **16**, 1, 1949, p. 29. From *Rev. App. Mycol.*, xxviii, 9, 1949, p. 472.) Some important contributions to the orientation of methods of plant disease control are summarized and classified under four headings—viz., (1) exclusion, defined as to prevent the establishment of the pathogen in a given area or its penetration into the plant; (2) immunization: to immunize the plant by genetic or chemical procedures; (3) regulation: to regulate the environmental factors so as to preclude relations between the plant and the pathogen; and (4) therapy: to cure the diseased plants. The first line of approach is directed towards the pathogen, the second towards the plant, the third towards the environmental factors, and the fourth towards the host-parasite complex.

124. EFFICACY OF SOIL FUMIGANTS AS AFFECTED BY SOIL TEMPERATURE AND MOISTURE. By W. D. McClellan *et al.* (*Phytopathology*, **39**, 4, 1949, p. 272. From *Rev. App. Myc.*, xxviii, 9, 1949, p. 470.) At the Plant Industry Station, Beltsville, Maryland, the authors investigated the efficacy of larvicide (Chloropicrin), D-D, dowfume G and dowfume W-15 against *Heterodera marioni*, *Fusarium oxysporum* f. *callistephi* and *Sclerotium rolfsii* at two soil moisture levels and six soil temperatures between 45° and 101° F. Chloropicrin was most effective against all three pathogens at 98°. D-D failed to control either of the fungi, while dowfume G was non-toxic to the aster wilt pathogen, but the viability of the sclerotia of *S. rolfsii* was considerably reduced after three days at 72°, 82°, or 98°, possibly in part by the intervention of antagonistic organisms. Similarly, dowfume W-15 was ineffectual against *F. oxysporum* f. *callistephi*, but toxic to *S. rolfsii* after six days at the same temperatures as dowfume G. In general, the fumigants were most effective in wet soils and were retained longest in those of the wet, low temperature series.

125. DAMAGE BY INSECT PESTS AND DISEASES TO THE SUDAN COTTON CROP. See Abstract 28.

126. LIST OF PLANT DISEASES OF ECONOMIC IMPORTANCE IN TANGANYIKA TERRITORY. By G. B. Wallace and M. M. Wallace. (*Mycol. Pap., Commonw. Mycol. Inst.*, 26, 1949. From *Rev. App. Mycol.*, xxviii, 9, 1949, p. 472.) This list of plant diseases of economic importance in Tanganyika Territory combines those already published with additions and amendments, and covers the period from 1925 to early 1948. Recent additions are placed in an appendix. The diseases, fungus, bacterial, virus and non-parasitic, are listed together under the common names of the hosts, arranged alphabetically. An index of the fungi and bacteria is appended.

GENERAL BOTANY, BREEDING, ETC.

127. RADIOACTIVE TRACERS IN AGRICULTURAL RESEARCH. By R. Scott Russell. (*World Crops*, **1**, 2, 1949, p. 77.) The use of radioactive isotopes as a means of tracing the changes which take place in plant nutrition opens up a new and fascinating field in the sphere of agricultural research. The object of this article is to indicate ways in which radioactive tracers can be used in the elucidation of agricultural problems. Useful information on the physical nature of isotopes and the ways in which they can be identified is included.

128. HYBRID VIGOUR FROM NATURAL CROSSING FOR IMPROVING COTTON PRODUCTION. By D. M. Simpson. (*J. Amer. Soc. Agron.*, **40**, 1948, p. 970. From *Pla. Bree. Abs.*, xix, 2, 1949, p. 346.) Relatively pure seed of seven varieties of cotton was planted at Knoxville, Tenn., for comparison with seed of the same varieties that had been produced by open pollination in a previous variety test comprising 25 varieties of Upland cotton. The excess yield of the " crossed " seed over that of the pure varieties ranged from 5·7 to 44·2 per cent., with an average of 15·4 per cent. The crossed seed also produced plants with larger bolls, larger seeds and higher lint indices. Other seed and fibre characters were not significantly affected; in general, no deleterious effects from crossing were observed.

Two possible methods of the commercial utilization of partially hybrid seed are suggested. In the first method, mass-crossed seed would be produced from a foundation stock of hand-crossed seed obtained by crossing selected selfed lines. From 1 acre planted with hand-crossed seed, enough mass-crossed seed to plant 40 acres in the second year and 1,000 acres in the third year would be produced. In the second method, multiplication in fields would be sown with a mechanical mixture of two or more inbred strains of proved combining ability, with hybridization solely dependent on natural crossing. This method would require fewer multiplications of seed to reach commercial quantities. It is pointed out that with a reasonable approach to random mating, such as may occur in certain parts of the Cotton Belt, the heterosis evident in F_2 populations would be partly continued in subsequent generations. In experiments at Knoxville, experiments have shown that natural crossing among plants may normally reach 50 per cent.

129. Cotton Plant: Growth and Productivity; Effect of Adenine and Nicotinic Acid. By Y. V. Rakitin and K. E. Ovcharov. (*C. r. Acad. Sci. U.R.S.S.*, **61**, 1948, p. 933. From *Summ. Curr. Lit.*, xxix, 18, 1949, p. 347.) Cotton plants were sprayed either twice with adenine solution (20 mg./l.) or four times with 1 litre per plant of nicotinic acid (100 mg./l.). In both cases the rate of growth and development was improved over the controls, and the number of bolls was significantly higher (30 per cent.).

130. Sterile Cotton Hybrids: Occurrence of Pistillate Conditions. By L. N. Iyer. (*J. Ind. Bot. Soc.*, **26**, 1947, p. 209. From *Summ. Curr. Lit.*, xxix, 18, 1949, p. 347.) A new type of male sterility, found in the sixteenth generation of C.22-2, a hybrid culture from a natural cross between *Gossypium indicum* and *G. cernuum*, is described. The inheritance of the anomaly is being investigated.

131. Gene Divergence in the Control of Flower Pigmentation in Cotton. By S. G. Stephens. (*Genetics*, **33**, 1948, p. 630. From *Pla. Bree. Abs.*, xix, 2, 1949, p. 346.) Neighbouring loci concerned with anthocyanin pigmentation of the cotton flower control similar chemical processes, but act upon slightly different substrates; this suggests that they originated as repeated loci accompanied by divergence in function. The genetically independent system controlling anthoxanthin pigmentation can be interpreted similarly, although probably consisting of a pseudoallelic series. Divergence in function has apparently accompanied speciation.

132. Cotton Plant: Flowering Rate; Influence of Mineral Diet. By G. E. Shul'ts. (*C. r. Acad. Sic. U.R.S.S.*, **61**, 1948, p. 935. From *Summ. Curr. Lit.*, xxix, 18, 1949, p. 347.) The rate of flowering is not affected by changes in the amount of nitrogen supply (0·1 g. N to 0·8 g. N added to N-free phosphate diet); only in cases of toxic N levels (0·8 g.) did the plants show some retardation of flower formation. The flowering rate was determined at comparative height levels. At each N dose, however, the rate of flower formation becomes progressively retarded as one goes from the lower to the higher parts of the plant.

133. A Biochemical Basis for the Pseudoallelic Anthocyanin Series in *Gossypium*. By S. G. Stephens. (*Genetics*, **33**, 1948, p. 191. From *Pla. Bree. Abs.*, xix, 2, 1949, p. 345.) The pseudoallelic series for the anthocyanin pigmentation in Asiatic cottons depends upon the interaction of at least three neighbouring loci. One of these, designated *G*, determines the presence or absence of a spot at the base of the petal, and another locus, designated *S*, the pigmentation of the spot when developed. When *G* and *S* are both present, the base of the petals develops a red spot; when only *G* is present the spot is white. Studies of the pigment development in the petal and chemical investigations suggest that a leuco-substance is the common precursor in the natural syntheses of both anthoxanthin and anthocyanin in the petal. It appears that in the absence of *G* the leuco-substance is oxidized to an anthoxanthin; when *G* is present the anthoxanthin in the spot area is reconverted at a later stage to leuco-substance, and when *S* is also present the latter is further reduced to an anthocyanin pigment.

The two genes *G* and *S*, situated in neighbouring loci, apparently condition reduction processes and act on the very similar though not identical substrates, anthoxanthin and leuco-substance. This suggests the following hypothesis. The loci arose by duplication from a common ancestral locus, and in the process of duplication or as a direct result of it, specificity was developed; the daughter loci lost their cytological and biochemical homology and became qualitatively new loci. The possible evolutionary significance of these possibilities is considered.

134. Fuzz-Hairs of Cotton Seed. By O. M. Abdelhafez. (*Nature*, 10/9/49,

p. 432.) The author states that when examining "neps" taken from cotton yarn it was noticed that fuzz-hairs attached to test fragments kept such stains as Iodine Green after washing, while the lint-hairs lost the colour. Microtome sections of ovules stained with Methyl Green and Congo Red showed fuzz-hairs beginning to form on the fifth day after flowering, with blue or violet cytoplasm which contrasted sharply with the five-day-old lint-hairs, the walls of which were red. No fuzz-hairs were observed earlier than this.

185. FALSE MOTES IN COTTON: THEIR ORIGIN, DESCRIPTION AND VARIATIONS IN NUMBER. By N. L. Pearson. (*J. Agric. Res.*, **78**, 12, 1949, p. 705.) At the base of certain locks of cotton occur small motelike structures to which fibres are attached. They differ from true motes in that they are not derived from ovules; each one develops from a small rudimentary body situated just below and between the two basal ovules and seemingly not in line with either placental ridge. They differ from ovules in being very much smaller and apparently incapable of seed formation. Identification of false motes in intact locks of seed cotton is made chiefly on the basis of position, though appearance characteristics, such as fibre length, density of fibre population, size or seedlike body, and absence of a distinct, though delicate, dried funiculus may be of assistance. In snapped cotton examination of the bur to ascertain the number of points of ovular attachment for a particular lock may help to decide questionable cases. Positive identification is not always possible, particularly in ginned lint and products of manufacturing processes.

Cotton samples representing different varieties, locations and seasons of growth, and numbers of ovules per lock and of locks per boll, were examined to ascertain some of the factors affecting the formation of false motes. The abundance of these structures in a sample was reported as the percentage of locks in which these bodies occurred.

The number of false motes formed was found to vary strikingly among the varieties studied and was shown to be influenced to a marked degree by environmental factors, especially those associated with seasonal differences. False motes were much more abundant in five- than in four-lock bolls, and within varieties the percentage of locks in which they were found tended to decrease with an increase in the number of ovules per carpel. The failure to recognize false motes from true motes, or aborted seeds, may constitute a source of error in estimating for a particular sample of seed cotton the percentage of the ovules that failed to mature.

186. ROLLING TABLE HOLDER FOR USE IN THE DETERMINATION OF CERTAIN CHARACTERS IN THE COTTON-BREEDING PROGRAMME. By G. N. Stroman. (*J. Amer. Soc. Agron.*, **40**, 1948, p. 1044. From *Pla. Bree. Abs.*, xix, 2, 1949, p. 348.) A rolling table holder in use at the New Mexico Agricultural Experiment Station is described by means of which the lint percentage and lint index can be determined in cotton-breeding material.

FIBRES, YARNS, SPINNING, WEAVING, ETC.

187. COTTON FIBRE: MOLECULAR AND FINE STRUCTURE. By D. A. Clibbens. (*J. Text. Inst.*, **40**, 1949, p. 426.) A simple account is given of the molecular and fine structure of cotton fibre and the influence of the glucoside links, the 1- and 4-hydroxyl end groups, and the glucose residues of the cellulose molecule on the properties of cotton. Mercerization and dyeing of cotton are discussed briefly.

188. FIBRE AND SPINNING PROPERTIES OF COTTON: A CORRELATION STUDY OF THE EFFECT OF VARIETY AND ENVIRONMENT. By H. E. Barker and O. A. Pope. (U.S. Dept. Agric. Tech. Bull. No. 970, December, 1948.) During the past several years, extensive data have been accumulated on fibre and spinning properties representing Upland, Sea Island and American-Egyptian cotton produced under a wide range of environmental conditions. Annual co-operative studies have been made by the agricultural experiment stations of the cotton-growing States and the United States Department of Agriculture. The detailed reports of the fibre and spinning results have been published annually. From time to time certain summary reports have been made. These, for the most part, have been limited in scope or have not separately treated environmental and varietal influences. The present report is concerned primarily with the fibre and spinning data accumulated since the advent of the more rapid techniques for fibre testing, and is concerned principally with relating environmental and varietal influences on fibre properties to spinning performance as measured by skein strength and yarn-appearance grade of single, carded and combed yarns.

139. Cotton Fibres: Effect of Reagents. By P. P. Viktorov. (*J. App. Chem., U.S.S.R.*, **19**, 1946, p. 900. From *Summ. Curr. Lit.*, xxix, 17, 1949, p. 315.) The effect of inorganic and organic reagents on the structure, capillarity and reactivity of cotton fibres was studied by means of the "paired reagent" technique, whereby the material is consecutively treated with each of two reagents both in direct and in reverse order. The pairs caustic soda/bleaching powder and sulphuric acid/bleaching powder removed non-cellulosic materials, destroyed the outer walls and rendered the inner portion of the fibre accessible. These changes produced increased capillarity and, in some cases, increased reactivity. The pairs benzene/water and alcohol/water produced little structural change, but the use of water as one of the reagents tended to give greater reactivity, which is tentatively attributed to changes in the surface state of the fibres.

140. Cotton and Cordage Fibre: Cellulose Content Determination. By L. E. Hessler and G. V. Merola. (*Anal. Chem.*, **21**, 1949, p. 695. From *Summ. Curr. Lit.*, xxix, 18, 1949, p. 342.) Extraction with alcoholic amines in ethylene glycol has been examined as a means of determining cellulose in cotton and cordage fibres. Results using one part of monoethanolamine in three parts of ethylene glycol (the insoluble residue, corrected for ash, being returned as cellulose) compare favourably with other methods for determining cellulose in cotton fibre. The action of the reagent on hard and soft fibres shows promise as a method for determining cellulose, but in some cases the fibre may require bleaching. Comparisons of the action of various cellulose reagents on cordage fibre are given.

141. American Cotton: Spinning Quality; Importance of Mean Fibre Length. By S. Carter. (*Text. World*, **99**, 4, 1949, p. 118. From *J. Text. Inst.*, **40**, 9, 1949, p. A375.) The U.S. Department of Agriculture's procedure was adopted in a mill to select cotton for 22s carded yarn. The following data were taken and plotted on samples selected from a number of bales: classified length, mean length, fibre-uniformity, fibre fineness, mature fibre content and fibre strength. It was found from graphs, and is borne out in practice, that mean fibre length has the most consistent effect on yarn strength. The statistical possibilities of the interdependence of the above yarn properties are pointed out, but the established practical way of classing cotton is stated to be wholly reliable for mills.

142. Cotton Yarn Strength: Prediction from Fibre Properties. By G. Dakin. (*Fibres*, **9**, 1948, p. 424, **10**, 1949, pp. 11 and 283. From *Summ. Curr. Lit.*, xxix, 17, 1949, p. 316.) There are two different methods of predicting yarn strength from fibre properties. The statistical method consists of measuring the fibre characters of a number of raw cottons, spinning the cottons into yarn, testing the yarn for lea strength and calculating yarn strength of fibre properties by means of a formula. Methods used at the Shirley Institute for determining fibre length and fineness and cotton cleanliness, the sampling of raw cotton, the "miniature" spinning test and the small-scale spinning test are described. The usefulness of the results obtained by these methods is discussed. In the physical method of the prediction of yarn quality, attention is focused on yarn irregularity and yarn structure. The subject of irregularity is dealt with in some detail with reference to the drafting wave and the analysis by means of Martindale's "Correlation Periodograph."

143. Process for Improving the Tensile Strength of Grey Cotton Yarn. By L. Axford. (U.S.P., 2,471,554, May, 1949. From *Text. Tech. Dgst.*, **6**, 8, 1949, p. 609.) The tensile strength of grey cotton yarn may be substantially improved in a simple and commercially attractive manner by contacting the yarn with a hot aqueous solution comprising from 10 to 50 per cent. of water, and correspondingly from 90 to 50 per cent. of a saturated monohydric aliphatic alcohol which contains from 3 to 5 C atoms per molecule and which is capable of dissolving water at 75° to 95° C. to the extent of at least 10 parts of water per 100 parts by weight of the solution, tensioning the yarn while still hot and wet with the solution and drying the resulting yarn under tension.

144. PLIABILITY OF COTTON AND STAPLE RAYON. By O. Heimeran. (*Textil-Praxis*, **4**, 1949, p. 92. From *Summ. Curr. Lit.*, xxix, 16, 1949, p. 294.) The author discusses several ways of measuring pliability and describes his own measurements of the untwisting force of finished yarns as an indication of stiffness. The method and the apparatus used are derived from C. F. Walz (1919). A length of yarn is suspended freely and a thin disc is attached to its lower end. The time taken for a number of turns of untwisting is measured, and with Walz's formula for the untwisting couple of yarns the "stiffness" of the fibre is found. The factors affecting the untwisting couple are then examined, and mention is made of theories advanced by others. Comparative tests are carried out on cotton and staple rayon yarn of the same count, but different twists, and on cotton yarn of different counts. Turns per metre, "stiffness," fullness, etc., are tabulated. Walz's proportionality between untwisting couple and yarn diameter is approximately confirmed. Generally, staple rayon yarns are more supple than cotton yarns. The theoretical couple according to Walz is found to give incorrect values of stiffness over large parts of the tests. The author substitutes for it his "reduced practical couple," the principal difference being in the place of the yarn diameter in the calculations. The apparatus is illustrated and there are references to literature in English and Russian.

145. COTTON WASTE: SPINNING. By H. Walton. (*Fibres*, **10**, 1949, p. 253. From *Summ. Curr. Lit.*, xxix, 17, 1949, p. 309.) A new system of cotton waste spinning has been introduced by the Wood Street Mill Co., Ltd., that uses existing machinery and dispenses with speed frames in preparation for the coarser counts. The system is a combination of preparation and condenser carding. The greatest advantages of this system arise from the reduction in the work load of the operatives.

146. COTTON WARPS: EFFECT OF LOOM SETTINGS ON BREAKAGE RATE. By J. J. Vincent. (*J. Text. Inst.*, **40**, 1949, p. P227.) A report of a lecture and discussion. Research conducted at the Shirley Institute during the past twenty years into the effect on warp breakage of varying certain loom settings is classified under: (i) warp tension, (ii) size of warp shed, (iii) loom speed, (iv) length of dwell of shedding tappet, (v) time of shedding, (vi) height of back rest, (vii) oscillation of the back rest, (viii) sweep of the sley, (ix) timing of the picking, (x) split shedding, (xi) leasing and (xii) type of heald. Attention is drawn to the apparent inconsistencies which are a feature of investigations on warp breakage.

147. PRESERVING COTTON FABRICS IN OUTDOOR USE. By J. D. Dean. (U.S. Dept. Agric. Circ. 790, 1948. From *Rev. App. Mycol.*, xxviii, 9, 1949, p. 477.) The author gives information on the properties, selection and care of cotton duck and lighter fabrics for farm use and describes various protective treatments. A good weather-resistant treatment for cotton fabric should protect it against water, sunlight and mildew. For portable covers requiring a moderately soft and pliable finish the formulæ recommended are: (1) petrolatum 8½ lb., beeswax 1½ lb., dry earth pigment 5 lb. and mineral spirits 5 gal.; (2) petrolatum 8½ lb., beeswax 1½ lb., dry earth pigment 5 lb., copper naphthenate 1½ lb. (for a naphthenate containing 10 per cent. copper) and mineral spirits 5 gal.; (3) petroleum asphalt, medium-hard, 7½ lb., petrolatum 2½ lb., lampblack 1 lb., mineral spirits 5 gal., with which copper naphthenate may be incorporated. The amounts specified generally suffice to treat 50 to 75 sq. yd. of canvas on one side. Formula 2 is recommended for use where severe mildew can be expected. For premanently fixed covers, where a stiff finish is not objectionable, the formulæ recommended are: (4) boiled linseed oil 1 gal., lampblack ground in linseed oil 2 lb. and Japan drier 1 pint; and (5) boiled linseed oil 1 gal., aluminium bronzing powder 1 lb. and Japan drier ½ pint.

In the summer of 1946 comparative tests were begun at New Orleans in which separate samples of 10-oz. army duck were exposed to the weather for twelve months after being painted on one side with formulæ 2 and 4 or with one of two commercial compounds, one (A) being of the type used for military purposes, while the other (B) was a readily available commercial preparation. Climatic conditions during most of the test were highly favourable to the growth of micro-organisms, an untreated duck becoming so heavily mildewed that after six months it lost nearly 80 per cent. of its original breaking strength. Throughout the test the samples treated with formulæ 4 and A showed excellent strength retention and water resistance; formula 2 was superior to B in both respects (strength loss after twelve months for untreated control, formula 4, compound A, formula 2, and compound B being 92, 24, 21, 47 and 77 per cent. respectively). The last two treatments gave softer, more flexible samples than the others.

148. FUNGICIDE-TREATED COTTON FABRIC. OUTDOOR EXPOSURE AND LABORATORY TESTS. By S. S. Block. (*Industr. Engng. Chem.*, **41**, 8, 1949, p. 1783. From *Rev. App. Mycol.*, xxviii, 11, 1949, p. 583.) At the Engineering and Industrial Experiment Station, Gainsville, Florida, fungicide-treated cotton fabric strips were given two years' outdoor shade exposure tests. The rainfall was 70 in. the first year and 52 in. the second. All the treated strips contained 1 per cent. by weight of fungicide when dry, and one series had supplementary water-repellent treatment.

The untreated controls lost an average of 67 per cent. initial tensile strength during the first year of weathering and 93 per cent. the second, the corresponding figures for those treated only with a wax-aluminium water-repellent being 49 and 90 per cent. respectively. The superficial stain produced by angiocarpous fungi (mostly Sphæropsidales) afforded a visual indication of the extent of the deterioration. The only samples to withstand the two years' weathering without appreciable damage were those treated with copper preservatives and silver pentachlorophenate. The latter gave the best results of any of the fungicides tested, but the cost of silver may preclude its use except for special applications. Within the copper group the tensile strength loss ranged from 0 to 19 and 12 to 45 per cent. in the first and second years respectively. Copper chromate with a high initial copper content conferred excellent protection over the two-year period. Mercurials and other heavy metal compounds were less effective. The phenolics, dowicide 7, fungicide G4, shirlan and fungicide 242, used with a water-repellent, were the only organic preparations that rendered the fabric reasonably resistant to microbial decomposition during the first year. For longer service life, however, they should apparently be used at a concentration exceeding 1 per cent. or in conjunction with efficient water-proofing agents.

The results of laboratory soil burial tests were in general agreement with those of the outdoor exposures. Soil burial for one and two weeks caused about the same degree of deterioration of the fabric as one and two years of natural weathering. Samples treated with silver pentachlorophenate showed exceptionally high resistance to disintegration in soil burial compared with the performances of other compounds.

149. TEXTILE FABRICS: WRINKLE RESISTANCE. By I. J. Gruntfest and D. D. Gagliardi. (*Ind. Eng. Chem.*, **41**, 1949, p. 760. From *J. Text. Inst.*, **40**, 9, 1949, p. A378.) The results of experiments are described which show that the wrinkle resistance of a fabric is determined by its multifilament character and by the ability of its separate fibres to recover from tensile deformations. The extent of the multifilament character depends on the ratio of fibre diameter to fabric thickness and also on fabric structure, presence of sizing or lubricating agents, smoothness of fibre surface and fibre stiffness. A viscose fabric was impregnated with various urea-formaldehyde resins, formaldehyde alone and with glyoxal, and it was found that materials that gain access to the inside of the cellulose fibres improved their ability to recover from deformations and increased their stiffness, while resins deposited on the outside of the fibres impaired their multifilament character, stiffened the fabric and reduced its ability to recover from folding. Data are also presented which show that urea-formaldehyde improved and formaldehyde and glyoxal impaired the breaking load, and that all the wrinkle-proofing agents reduced the tear strength of the fabrics.

150. New Ring Doubling Frame. (*Text. Recdr.*, **67**, July, 1949, p. 69. From *Text. Tech. Dgst.*, **6**, 10, 1949, p. 751.) A new doubling frame takes into consideration factors such as increased size of creel packages, larger diameter of rings and the longer lifts which have become preferred practice in the trade. The frame is suitable for fine, medium or coarse counts, ring diameters up to 5½ inches, gauges up to 7 inches and up to 8-inch lift bobbins. It may be arranged for either dry doubling or with troughs for English system wet doubling.

151. Spinning Mill: Humidity and Temperature Control. By P. L. Davidson. (*Textile Weekly*, **99**, 3, 1949, p. 141. From *J. Text. Inst.*, **40**, 8, 1949, p. A341.) Results of a study on the effect of temperature and humidity on health and comfort are summarized. The conclusions are that (i) the effective temperature in a textile mill should not exceed 80° F. on an eight-hour exposure for maximum efficiency of the worker; and (ii) conditions of 85° F. effective temperature or above will not be injurious to the health of the average worker in good physical condition, but could affect those below par, and will impair the efficiency of the average worker. Methods for maintaining an effective temperature of 80° F. (which is 86° F. dry bulb at 60 per cent. relative humidity) with a straight evaporative-cooling system are considered.

152. Refrigeration and Air-conditioning Installation. By C. M. Bowden. (*Text. World*, **99**, 4, 1949, p. 131. From *J. Text. Inst.*, **40**, 9, 1949, p. A381.) A new installation in the hosiery mill of the Wiscasset Mills Co., U.S.A., is described. The original evaporation-cooler system was modified by the addition of a compressor that cools water which is fed to the "de-humidifier," when required. The de-humidifier removes moisture from the air-stream returning from the knitting department until it reaches the relative humidity and temperature required for knitting. An electronic "Regutron" unit measures the moisture content and temperature and transmits a signal to the magnetic coupling between the 150 h.p. motor and the compressor. The coupling variations result in speed changes of the compressor which in turn control humidity and temperature. The arrangement ensures instant adjustment to correct conditions. Some of the equipment is described in detail, with diagrams and photographs.

153. Cotton Oiling. (*Oil*, Manchester Oil Refinery Ltd., **1**, 4, 1948-49, p. 8. From *J. Text. Inst.*, **40**, 8, 1948, p. A312.) An account is given of the development and application of the Puremor textile spray equipment and Textile Oil "C" for checking cotton card room dust.

TRADE, PRICES, NEW USES, ETC.

154. Raw Cotton Commission. (*M/c. Guardn.*, 29/10/49.) In an address to the Liverpool Economic and Statistical Society, Mr. H. O. R. Hindley, the chairman of the Raw Cotton Commission, described the present system of supplying raw cotton to the United Kingdom and the difficulties which are being encountered in performing this task. The Cotton (Centralized Buying) Act of 1947 established the Commission as the sole importer and distributor of raw cotton in this country and required it to balance its revenue and expenditure, taking the good years with the bad. In the long run any incidental profits which the Commission might make in an exceptionally good year would be redistributed to the industry in the form of lower prices in bad years.

The total value of the assets which the Commission took over from the Board of Trade on January 1, 1948, was approximately £57 million, of which £30 million was treated as an advance on capital account, on which long-term interest is payable, and which is to be repaid over a period of fifty years. The balance of £27 million was treated as revenue account, on which interest is payable at half per cent. In addition, the Act permits the Commission to borrow a further £10 million on capital account and £75 million on revenue account, and there is a further provision which permits £10 million to be raised by means of an overdraft or otherwise. The total borrowing powers are thus limited to about £152 million, and the first accounts showed that only about £60 million of this had been utilized by July 31, 1948. Part of the profits, amounting to about £30 million, which the Cotton Control made on its operations in raw cotton, was handed over to the Commission as a reserve fund against losses in a period of falling world prices.

155. RAW COTTON: CENTRALIZED BUYING. (*Economist*, **156**, 1949, p. 801. From *J. Text. Inst.*, **40**, 9, 1949, p. A394.) The cost of centralized bulk buying is discussed with particular reference to Ministry of Food contracts, operations of the Ministry of Supply in the metals market and the work of the Raw Cotton Commission. The Commission's prices for American Middling $\frac{15}{16}$-in. cotton and Egyptian Karnak are tabulated month by month from January, 1948, with current replacement prices for comparison. It is pointed out that price movements have not been so frequent in Britain as in the world market, nor have costs been kept artificially low on a rising market or high on a falling market. On the whole, British prices have tended to be higher than replacement costs, but there does not appear to be any statistical method for assessing accurately the cost of centralized buying to the industry.

156. SPINNERS' COVER SCHEME. (*Cott. and Genl. Econ. Rev.*, 30/9/49.) An outline is given of the Spinners' Cover Scheme which came into operation at the end of November. Under the new arrangements spinners are required to maintain continuously, as nearly as possible and within a permitted tolerance, a balanced Cover position. In the operation of the Scheme spinners will have the option of maintaining a balanced Cover position against each yarn sale by the following alternatives:

1. A purchase of a weight of raw cotton equivalent to that in the yarn content at fixed prices, either for spot or deferred delivery.
2. Should the particular quality of raw cotton not be decided upon, the spinner can ask for a Cover Requisition for the required weight. This will cover him in terms of price, but he must undertake to declare within thirty days the qualities he wishes to buy in order of preference, and to enter into a definite contract.
3. Should the particular quality of raw cotton required be known, and the spinner not have the opportunity of selecting the most suitable type, an alternative Cover Requisition can be obtained under which the spinner undertakes to purchase the required weight of a stipulated quality within thirty days.
4. By the fixation of the required weight of cotton previously purchased "on call" in anticipation of yarn sales.

157. IMPORT OF COTTON PIECE GOODS TO THE COLONIES. (*The Colonial Territories*, 1948-49, H.M.S.O., Cmd. 7715. Price 2s. 6d.) In the years after the war the shortage of cotton piece goods in the Colonies was the most serious shortage in the supply of consumer goods. Early in 1948 it was necessary to authorize importations from hard currency countries in order to supplement supplies from the United Kingdom. In the course of 1948 the supply position greatly improved, partly because of increased supplies from the United Kingdom and partly because of supplies from continental countries and Japan. For example, the United Kingdom exported 39,000,000 square yards of cotton piece goods to East Africa in 1948, compared with 18,600,000 square yards in 1947. Exports to West Africa were 116,000,000 square yards, compared with 68,000,000 square yards, and to the West Indies 12,300,000 square yards, compared with 5,700,000 square yards (the figures for 1948 included re-exports of a certain amount of imported grey cloth which had been processed in the United Kingdom). By the end of the year, therefore, some Colonial regions—*e.g.*, Malaya and East Africa—were, generally speaking, well stocked with imported cotton textiles and in others the position had very greatly improved, although there were some shortages of special types, and the price of imported cotton textiles was also much above pre-war prices.

158. SMALL TEXTILE PLANT: MANAGEMENT. By G. E. Tucker. (*Text. Indus.*,

113, 5, 1949, p. 95. From *Summ. Curr. Lit.*, xxix, 18, 1949, p. 358.) An illustrated account of how a small textile manufacturer can make use of materials, machinery and manpower in such a way that the competition of large manufacturers may be met, is given under the following headings: (1) Organization; (2) Production control; (3) Methods improvement; (4) Time and motion study; (5) Standard data; (6) Job evaluation; (7) Standard practice instructions; (8) Incentive wage payment plan; and (9) Accurate pricing.

MISCELLANEOUS

159. World Cotton Production, 1949-50. (*Cotton*, M/c., 29/10/49.) The United States Department of Agriculture states that world cotton production in 1949-50 may reach 30,400,000 bales—an increase of 1,300,000 bales or 4·5 per cent. over the estimate for 1948-49.

The Department adds that smaller crops in Egypt, China and East Africa were more than offset by increases in the United States, Mexico, India, the Soviet Union, Brazil, Pakistan and Turkey. World production is expected to exceed world consumption by about 2,500,000 bales.

160. World Cotton Exports. (*Cott. and Genl. Econ. Rev.*, 21/10/49.) World cotton exports of nearly 11 million bales (500 lb.) in the 1948-49 marketing year (August-July) were about 24 per cent. higher than the 1947-48 total of 8·8 million bales. The increase of 2,937,000 bales in exports from the United States was partly offset by a net decrease of 800,000 bales in exports from foreign countries as a whole. This shift in sources for cotton entering world trade is partly a result of diminishing stocks of American-type cotton available for export from foreign producing countries. Of equal importance, however, are the results of Economic Co-operation Administration and other United States Government sponsored programmes under which about 3,254,000 bales altogether were exported to the participating countries of Western Europe and China, and 686,000 to Japan and Korea on credit terms.

The trend toward the use of larger quantities of United States cotton in Europe may be continued to some extent in 1949-50 for the two reasons mentioned. This trend as reflected in 1949-50 imports, however, may be limited to a serious shortage of dollar exchange, particularly in Europe, the existence of sizeable stocks of cotton in some of the major importing countries and slightly decreased consumption anticipated in some of them. World consumption as a whole is expected to be down by about 700,000 bales in 1949-50 to around 27·9 million bales and may influence trade to that extent, but most of the decrease in consumption will be in China and to a smaller extent in India.

161. "World Crops." (Published by the Leonard Hill Technical Group. Subscription 25s. p.a.) In his introduction to this new publication Sir John Russell writes: "The combination of science and engineering with agricultural practice can undoubtedly solve the problems of production, but success will require a close linkage between industry and agriculture, at least at the higher levels, and this will be greatly facilitated by the regular issue of an authoritative journal which can present the developments of modern agriculture to all technicians likely to be interested; agricultural, enginering, chemical and others. Fortunately, the house of Leonard Hill, already well experienced in technological matters, has undertaken the task of issuing this Journal, and, equally fortunately, Sir Harold Tempany, a high expert in crop production in the colonies, has agreed to become its first editor." Special articles in the first issue deal with rice, tobacco, vegetable oils, sorghum and cocoa.

162. Effect of Currency Devaluation on the World Cotton Situation. (*Cotton*, Int. Cott. Adv. Cttee., October, 1949.) In the cotton segment of world economy the devaluing countries account for almost 20 per cent. of production, about 38 per cent. of consumption, 29 per cent. of exports and 66 per cent. of imports. Devaluation implies a reduction in the export prices of products of devaluing countries in terms of dollar and equivalent currencies. Thus an increase will have to take place in the quantity of goods shipped to dollar and equivalent currency areas, if earnings of such currencies are to be even maintained at their former inadequate level. Without this increase, and in default of an extension of special arrangements for supply on a barter or other basis, international trade in cotton may not escape curtailment in the 1949-50 season.

From another standpoint, however, devaluation has unfavourable implications for cotton imports and consumption. While the prices of imported cottons have become higher in the domestic currencies of devaluing countries, the prices of indigenous rayons have remained unchanged. The technical limits to the substitution of rayon for cotton have by no means been reached in Europe, and the new cotton/rayon price relationship seems likely to lead to increased efforts to expand rayon production capacity and to bring into operation rayon plants presently unused.

Meantime, there is further evidence supporting the view that world cotton production may again exceed consumption in 1949-50. This holds true to a relatively greater extent for the United States alone, where it has been officially proclaimed that, subject to the referendum to farmers, production controls will go into effect in 1950-51. In the global production picture, the latest crop forecasts for areas where harvesting is already in full swing—North Brazil, Mexico, the United States and Egypt—indicate a net increase of 4 per cent. over last season's total for this group. This, and a general appraisal of conditions in other areas, suggests that the world crop in 1949-50 might be in the neighbourhood of 30 million bales against 28·9 million bales last season.

Printed in Great Britain by
Billing and Sons Ltd., Guildford and Esher

THE
EMPIRE COTTON GROWING
REVIEW

VOL. XXVII APRIL, 1950 No. 2

THE COLONIAL RESEARCH SERVICE

On January 30 this year the Parliamentary Under-Secretary for the Colonies held a press conference at which he announced the formation of a Colonial Research Service " binding together the scattered research workers of the Colonial Empire." A pamphlet issued at the same time* supplies the details of the service so far as they have been worked out.

The general statement regarding the terms of service is as follows:

> Officers of the Colonial Research Service will normally carry out their work in the Colonial Empire, and they will be required to accept liability for duty in any part of it. They may also be required to serve from time to time on appropriate terms in the United Kingdom or elsewhere, as determined by the Secretary of State. They will be employed on research throughout their service.

This announcement marks the culmination of a discussion which has gone on for many years. The serious consideration of its subject dates back at least to a Colonial Office Committee presided over in the first instance by Lord Milner as an outcome of the awakened interest in research during and after the 1914-18 War. From that time onwards, the rapid and continuing increase in the number of specialist officers in the Colonial Service has emphasized the desirability of a more fluid system to facilitate transfer and to enable outside help to be enlisted to deal with particular needs or problems of a temporary nature.

Although the advantages of this change have been so long recognized, serious administrative difficulties have stood in its way. Each colony has built up its own scientific services according to its recognized requirements and resources.

Although transfers within the Colonial Service as a whole have always been possible, and indeed frequent, the salaries and terms of service between individual colonies or groups of colonies have been so widely divergent as to impose a serious check on movement. The less prosperous colonies have naturally been at a disadvantage in attracting or holding the more capable men. A more serious difficulty in the effective organization of research has been the rigidity of appointments, combined with the existence of purely local pension schemes. Officers required to deal with an emergency, or with a relatively short-term investigation, have usually had to be appointed to the permanent staff, with an obligation to continue their employment, unless transferred, to pensionable age. Such an officer, having accumulated pension rights over a period of service, has naturally been averse from losing them by transferring to other work which might be available—for example, in an independent research institute.

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* *Appointments in His Majesty's Colonial Research Service, Colonial Office,* 1950. (1st Edition.) Obtainable free from the Colonial Office.

The pamphlet under notice, being concerned only with the description of the new service, does not meet all the questions which will arise in its application. Some of them may have already been decided, others no doubt will be left to be worked out in practice. The most serious problem, that of pensions, is to be met by the institution of a superannuation scheme, to benefit both the officer and his dependents on a contributory basis. Provision is to be made to safeguard benefits accruing from partial service and to meet the case of officers already belonging to an approved scheme. The details are not yet available, but provision is made for the interim period before the scheme is applied. The other great step is the unification of salary scales. These are based (medical research officers apart) on the United Kingdom Scientific Civil Service (London scales) with an overseas research allowance appropriate to the region. The point of entry to the scale will be decided on considerations appropriate to the qualifications of the individual. Tours of service and vacation leave will conform to those of the region concerned. Transfer into and out of the other branches of the Colonial Service will be facilitated. Free sea passages will be provided for the officer, his wife, and children under 13. Air passages, when such are required, will not extend to families.

With regard to the Agricultural Service, that with which the Empire Cotton Growing Corporation is most directly concerned, no light is yet thrown on the question we have previously raised as to the status of those specialist officers who will, of necessity, remain in attachment to the Departments of Agriculture. It does not seem, however, that any serious difficulty would be involved in their inclusion in the Research Service except, perhaps, the difficulty of drawing the line of separation. No mention is made in the description of the scheme of provision for transfers to or from such related services as the independent crop research institutes. The extension of the scheme to include the recognition of such transfers is a further step which is highly desirable.

In addition to the Research Service as planned, the Secretary of State is offering, during the next five years, to grant Colonial Research Fellowships tenable in the colonial territories, with a salary up to a maximum of £575 per annum, a foreign service allowance, travelling expenses and the cost of essential equipment. No limitation is placed on choice of subject, provided that the results are likely to be of definite value to the Government concerned. The Fellowships will normally be reserved for university graduates in the natural or social sciences under 35 years of age from any part of the British Commonwealth or Empire.

It is a matter for congratulation that the Colonial Office has at length decided to remove or to disregard the obstacles that have stood in the way of this reform. How the tendency to a narrow colonial "nationalism," which has been the underlying difficulty, has been overcome is not yet clear. However that may be, the result is unreservedly to be welcomed, since both essential research and the interests of the research worker will greatly benefit.

THE SOUTH AFRICAN REGIONAL SCIENTIFIC CONFERENCE, AND EAST AFRICAN AGRICULTURE AND FORESTRY RESEARCH ORGANIZATION SPECIALISTS' MEETINGS—SOME IMPRESSIONS

BY

J. E. PEAT

Empire Cotton Growing Corporation

IT has been my good fortune in the second half of 1949 to attend as a Tanganyika delegate, at the invitation of the Director of Agriculture, the South African Regional Scientific Conference in Johannesburg, and an East African Agriculture and Forestry Research Organization specialist meeting on Fertilizer Experiments in East Africa, in Nairobi.

In early December there was a further E.A.A.F.R.O. specialist meeting on Grassland Research which I should have liked to attend. But following months of a devastating drought there was a cloud-burst over the Mwanza aerodrome before the arrival of the once-weekly plane to Nairobi; the aerodrome was flooded and damaged, and the air service was cancelled. Such can be travel in Africa!

Regional specialist meetings are good for everyone concerned. There cannot in Africa be the close specialization that there has to be at home. A man's main concern may be cotton breeding; but almost whether he likes it or not he gets tied up in addition with, say, general land usage, fertility problems, manuring and the use of fertilizers, land resting, grass leys and grass management and so on—in other words, he gets tied up with the general agronomy of his area. He is not a specialist on any of these various aspects of agronomy, but he has results of experiments and views on his own area to contribute to the general pool. It is very healthy to have an interchange of such views; and at the same time there is a real value to the regional research organization in having as a basis for later more specialized work the results already available discussed and on record.

At the E.A.A.F.R.O. discussions on Fertilizer Experiments in East Africa the main impressions were how little was known, how little definite had yet come out of the work started, and how much work was needed. In some areas responses were recorded to phosphate and to nitrogen, but in the main less than had been hoped; and there were many inconsistencies.

In the Kenya Highlands, with applications to wheat and maize, superphosphate had proved the most effective of the phosphates. Holme (Highlands Fertilizer Scheme, Kenya) suggested that, on the results from the first year's field experiments, weight for weight triple superphosphate was estimated as nearly six times as effective as soda-phosphate—45 lb. triple superphosphate equivalent to 257 lb. of soda-phosphate. But the general conclusion was that comparisons between superphosphate and soda-phosphate had not been conclusive.

The effects of nitrogenous dressings had been very variable, and no conclusions could yet be drawn.

One of the most interesting contributions to the meeting, I thought, was by Griffith and Manning (Uganda): a description of the accumulation of nitrate that took place in the soil at Kawanda during the rains, expecially under bare fallow. There was an accumulation of nitrogen at the most favourable time equivalent to a heavy dressing of sulphate of ammonia or nitrate of soda. This very important observation will have to be followed up in other areas.

Bunting (O.F.C., Tanganyika), in summarizing experiments at Kongwa and Urambo, recorded definite increases from phosphate applications, with higher responses from placing than from broadcasting.

Among the most marked responses were those I reported from the Lake Province, Tanganyika, following applications of organic manure, with continuing residual responses for several years. [The results of this past season were not available for this meeting. They show a large increase from an application of single superphosphate on fairly poor land. An assessment of all the results available indicates that the benefits from organic manuring may well be mainly phosphate effects.] The increases due to agronomic treatments, such as tie-ridging, were also recorded.

Dr. Keen, the chairman of the meeting, referred to the detrimental effects of weed growth in the young crop, even a light weed cover causing damage that no amount of subsequent weeding would undo. No satisfactory explanation of this had been found. After early clean-weeding, weeds can be allowed to grow with comparatively little influence on crop yield.

(A report on the papers and discussions at this meeting is given in the October, 1949, number of the *East African Agricultural Journal.*)

The highly important African Regional Scientific Conference in Johannesburg was a gathering of a very different order. It arose out of a recommendation made at the Commonwealth Scientific Conference held in London in 1946, that a conference should be held in the Union of South Africa to discuss ways and means of bringing about closer collaboration in scientific research between the various territories in Africa south of the Sahara. It was convened by the South African Council for Scientific and Industrial Research with the support of the Union Government.

The broad purpose as set out was " to examine and report on the possibilities of facilitating and co-ordinating research of common interest to the Governments and organizations concerned in African regional scientific development."

The order of the agenda had accordingly been arranged " to develop the theme of the study of man and his activities in relation to the physical and biological environment and development of Africa."

Dr. Malan, the Prime Minister of the Union, gave the opening address to the conference. The delegates, numbering over a hundred, were the guests of the Union Government. There were delegates from South Africa, Belgium and the Belgian Congo, France and French African territories, Portugal and Portuguese African territories, the United Kingdom, and British Central, East and West African territories. The East African group comprised representatives of the East African High Commission and from Kenya, Uganda and Tanganyika.

The meetings were arranged in plenary session, and in six sections which met separately or in groups. The section with which I was mainly concerned was B—Soils and Plants, the chairman being Professor Quintanilha, Director of Cotton Research, Mozambique.

Other sections, either in separate or joint sessions, dealt with an enormous range of scientific activity: A—geology and mineral research, geophysics, hydrology, meteorology and mapping; C—zoology and animal industry; D—health planning, nutrition, diseases and the psychology of indigenous peoples; E—pre-history, ethnography and social research; and F—other technological subjects, water pollution, fisheries, industrial utilization of raw materials, housing and roads.

There was a steering committee consisting of the president, the five leaders of national delegations, and the six chairmen of sections.

The main resolution of the conference was adopted unanimously. It recommended the establishment at an early date, on modest lines, of a Scientific Council for Africa south of the Sahara, with duties essentially advisory and consultative, composed of scientists representative both of the subjects and the regions concerned. It should be presided over by a scientist with a knowledge of African problems, who could devote his whole time to the new organization. Dr. P. J. du Toit, who had been elected president of the conference, and who until his retirement had been the Director of South African Veterinary Services and Director of the great Veterinary Research Institute at Onderstepoort near Pretoria, was unanimously recommended as the first whole-time chairman of the new Council. The permanent body envisaged was to encourage and establish contacts between scientific workers and to promote liaison.

There has been, I understand, a following-up of this recommendation by a meeting in Paris of representatives of the nations and territories concerned.

It will be appreciated that most of the discussion on how research within Africa could be facilitated and co-ordinated took place at a comparatively high level, and that the main resolution adopted at the concluding plenary session was the end product of many discussions accommodating the differing approaches. But from the body of the conference the need was stressed for contacts and visits at "the workers" level; that scientific workers in Africa should know what is going on elsewhere in Africa in their own field and be able to visit and have contacts with fellow workers in that field. The second need expressed was for the stimulus and guidance which would result from visits from scientific authorities of metropolitan standing. The very real desire was expressed repeatedly by South African workers for contacts with work going on elsewhere in Africa. And at the same time views were expressed by British colonial delegates that there was need for much more contact with their Belgian, French and Portuguese colleagues.

I could not help feeling that in its own small field the Empire Cotton Growing Corporation was achieving to a considerable extent what the delegates to this conference desired over the whole range of scientific activity in Africa south of the Sahara—contacts and visits between workers in the same field in the various territories, liaison, and guidance from an authoritative level.

Professor Quintanilha several times in conversation made reference to the extent to which they in Mozambique were indebted to E.C.G.C. work, especially Barberton work; and Dr. Staner, the leader of the Belgian delegation, showed that he was familiar with much of the work being done in Africa by the E.C.G.C.

For the more lowly technical delegate—quite over and above the main conference purpose in planning for closer collaboration in scientific work—there was much that was intensely interesting in getting some slight understanding of the immense range of scientific work going on in Africa, and viewing various regional aspects in truer perspective. A great range of subjects was touched on by each section; though unfortunately with many there could be only touching. At times this was tantalizing. Anything like fuller development was impossible; and this, as it had to be, was far and away the least satisfactory aspect of the conference. But then it had never been intended that detailed technical questions should be discussed at all fully, the purpose being rather to consider and compare the organization of research and the needs in the different subjects and regions.

Illustrating the wide range of subjects in the sectional meetings that

I attended, among others there were papers on plant taxonomy, plant geography, plant ecology and the application of ecology to agricultural problems in Africa; papers on soil classification and soil conservation; on chemical control of insects in Africa; and a fascinating but much too brief joint session on the conservation and control of wild life, and the spread of diseases from wild life to stock and *vice versa.*

There were papers on land usage; on the restoration of organic matter in worn-out soils under dry land cultivation; on phosphate and organic matter as factors of fertility in African soils; and a paper on some biological problems of the groundnut scheme. There were papers on pasture research, and on the need for further study of pasture management before planning extensive African-owned cattle industries in land cleared of tsetse. And so on.

In the brief paper I presented, and in the introduction to it, I tried to outline the cotton work that had been done in Africa, with which the E.C.G.C. has largely been concerned in cooperation with the territorial governments; and how the results of research, investigation and breeding made practicable on the field side plans for increased cotton production—for example, in the Lake Province in Tanganyika, with which I was immediately concerned. I referred to the increasing assistance that must emanate from the research programmes at Namulonge and at Shambat.

As cotton growing cannot be divorced from the agriculture of the area, localized agronomic work and localized breeding for the particular conditions are essential. I emphasized that in my view there had to be a balance between (*a*) longer range research which could be partly centralized; (*b*) the more localized breeding, and investigation of local problems, as a preliminary to more efficient and increased production in the area where development was desired; and (*c*) the essential utilization of (*a*) and (*b*) in the field within a reasonable time. There had to be in the same way a balance of staff and funds. Though all this was probably platitudinous, I took heart when the leader of the British delegation, Sir Ben Lockspeiser, warned one of the meetings not to be too much afraid of platitudes.

At this meeting, where there were a number of delegates who had either worked with or been associated with F. R. Parnell, I thought it appropriate in the month of his retirement to refer to the extent which the African cotton work south of the Sahara had at various stages centred around Parnell at Barberton, and how much was owed to the inspiration he had provided.

The organization of all aspects of the conference was magnificent, and could scarcely have been bettered. Interpreters translated discussions from French to English, the two languages of the conference, and *vice versa.* In the lecture room used for the main sectional meetings there was simultaneous translation, with the interpreters in a cubicle and the audience with headphones in what I imagine to be the approved UNO style. This very greatly helped the efficient carrying on of the business of the day. In the plenary sessions speeches and long statements had to be translated afterwards from French to English and *vice versa*; this was tedious indeed for everyone concerned. The simultaneous translation was most excellently done—with as one of the lighter incidents the occasion when the interpreter, forgetting for the instant that he was being overheard, remarked *sotto voce* to his colleague about an eloquent very rapid-speaking French delegate: " Why doesn't the —— speak into his microphone ? " Business was held up for some moments while decorum was restored.

For the first few days, to avoid traffic delays, transport between the hotels and the conference building (the Witwatersrand University) was in convoy, with police motor-cyclist outriders. Travelling at considerable speed through the busy Johannesburg traffic, with police klaxons blaring, was certainly an interesting experience—an experience which I at least am not likely soon to repeat.

Hospitality was extensive. There was a state banquet attended by Dr. Malan, a dinner given by the Transvaal Chamber of Mines, and there were a number of receptions.

One interesting interlude was a demonstration of African music by musicians gathered together by Mr. Hugh Tracey, now a collector and recorder of African music, who once tried to grow cotton in Southern Rhodesia in the early days of cotton there. But he reminded me that what the kudu left him of his cotton crop did not then go far towards paying his bills. Again, on a Sunday morning at the Robinson Deep Mine native dance arena, where tribal dances (which for hundreds of years have been part of the life of the people) are encouraged and fostered, amongst others, Chopi musicians, from near the mouth of the Limpopo river, with their " Timbila " xylophone orchestra, and dancers, gave a stirring and colourful show. This was received with enthusiasm by the audience, white and black; it was a show which would have drawn crowds to any London performance.

From reference to this encouragement and fostering of African music and dancing to a mention of the whole vexed colour problem in the Union is an obvious step. As under-currents throughout the conference, rightly never allowed to do more than break the surface, but nevertheless always there, were two of the great problems affecting South Africa—the colour problem, and the bitterness of South African politics. These were no business of the guests to the conference, and both are far too complex for a visitor to appreciate their many facets. But the place and the value of the African in scientific work in Africa must at some time be reviewed in plans for African collaboration. Contacts between workers in South Africa and the north must be healthy in helping to remove some of the misconceptions, and in allowing an understanding of the extent to which even the limited scientific work in progress in much of Africa to the north is possible only by the able contributions of African workers—quite apart from it being their essential right to participate in this side of African development.

A number of excursions were arranged, amongst them a day in the Pretoria area, where I visited the Agricultural Research Station at Rietvlei and the great Veterinary Research Institute at Onderstepoort. At Rietvlei, and in discussions during sectional meetings, the need was repeatedly stressed for a legume for use in grass leys in subtropical Africa. The pasture workers had not yet found a legume " worth a damn."

At the conclusion of the conference there was an excursion to the Kruger National Park—the great game reserve in the Eastern Transvaal, bordering Portuguese territory. The entry was made from the Nelspruit—White River end of the park. Barberton lies just over the hills, a short distance away. Again the organization was nigh perfect. In such a brief visit we were lucky to see so much: lions, elephants, giraffe and hundreds of buck. It was strange—though it could not do other than detract somewhat from the spectacle—to sit in a queue of cars as in a traffic jam, watching a family of lions with grunts and growls tearing a zebra kill to pieces less than a stone's throw away, with steam from the flesh rising into the early morning air. A foolish opening of a car door by someone to see better, and off they bounded thoroughly alarmed. One of the most pleasant pictures of the South African bushveld carried away was of herds of impala in great numbers by the Sabi river, flicking their tails as they minced their way to the river to drink, quite oblivious of the cars on the road. But I am afraid that watchers of game must, like fishermen, be somewhat selfish—as much alone as possible, until it is the time to tell the tale, and then relishing attentive listeners, preferably those who have not seen so much or caught so much.

With its many ramifications—far-reaching and serious, and at times light and entertaining—the Johannesburg conference was fascinating; especially so perhaps for a sojourner in " the long grass." It was a great privilege to have been invited to attend it.

Received February, 1950.

COTTON PRODUCTION IN BRAZIL

BY

COLONEL C. E. PONSONBY, T.D.

BRAZIL lies between latitudes 5° north and 33° south of the Equator. This huge tropical and semi-tropical area occupies one-fifteenth part of the whole of the world. It is the same size as the U.S.A. without Alaska. In Africa the area between the same latitudes stretches from Uganda and the Belgian Congo in the north to Cape Colony in the south. Between Brazil and southern Africa there are naturally many corresponding similarities: discovery, climate, crops, problems and opportunities. Both southern Africa and Brazil were discovered by the Portuguese at the end of the fifteenth century. Both have developed slowly and, within a million, the populations of both areas are much the same—namely, 48,000,000, or about 14 to the square mile. The chief differences will be found in the peoples themselves. In Brazil the Portuguese, the Amerindians and the immigrant Africans, with the combinations of all these races, all mix together with little thought of colour and all having more or less the same religion (Roman Catholic), while in Africa there are the whites of all races, the Africans with their several hundred tribes and the Indians. By and large, also, there is not much difference in the economy of these areas. If the precious minerals, gold, diamonds and copper, are excluded from the calculations, there is little to choose between the combined budgets of the African countries and the budget of Brazil. In all there are great opportunities depending on the use of land. There are new lands to be opened up and many areas of old cultivated lands to be reclaimed and saved from erosion. The cotton lands of Brazil are a case in point.

Cotton has seen many vicissitudes. It is believed to have been indigenous. A wild species of cotton tree known as " ganga " or " Algadao sylvestre "* is even now found on some desolate mountains. The cotton " is of a creamy colour, has a fine glossy fibre, is pretty strong, but only ¾ to ⅞ inch in length." It is believed in the Serido district of Rio Grande del Norte that this was the forerunner of the famous Mocó cotton of that district.

Cotton was grown in Brazil even before it was grown in the U.S.A. In 1750 the planters of north-eastern Brazil brought in natives of India to train their slaves to grow and spin cotton. The states of Bahia, Pernambuco and Maranhão were the first to supply the needs of the districts and then of export. Exports increased until about 1820, after which period the U.S.A. practically captured the export market until the American Civil War (1875). During the Civil War little cotton was exported from the U.S.A. and world cotton prices rose to record levels. Brazil took advantage of this and the export of Brazilian cotton (called "white gold" in Brazil) reached 355,000 bales. All this was produced by white planters with slave labour. But the planters missed their opportunity. Instead of establishing their industry on a permanent basis, they allowed the U.S.A. to regain their former preponderance. The north of Brazil reverted to sugar, the south to coffee.

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* Authentic seed of this species from any reader able to supply it for the purpose of botanical identification would be greatly appreciated. (Ed.)

By 1889, when slavery was abolished, plantation cotton practically came to an end, and from that time onwards cotton was grown only by small cultivators. Production continued mainly to meet local demands. About 1900 the Brazilian textile industry began to expand and the resulting local demand, together with the low prices of coffee, rubber and other crops then prevailing, again stimulated interest in cotton growing. It was still almost entirely for local consumption, and as the population increased so did the textile mills. By 1920 the spinning and weaving industry was equal to that of Belgium or Switzerland, having 1,700,000 spindles and more than 60,000 looms and employing 130,000 hands. At that time the value of cotton manufactured goods equalled the value of the coffee crop.

The Brazilians came to realize that they could not rely on one or two crops, such as coffee and rubber, for the adjustment of the balance of trade. Rubber, as an export crop, was disappearing. Although the quality of Para rubber was good, it could no longer compete with Asiatic plantation rubber. Coffee, of which three-quarters of the world's requirements was grown in the state of São Paulo, was not finding a free market as before the European war owing to the poverty of the purchasers in Central Europe. The small sugar exports were being reduced owing to price competition, especially from Cuba. Another crop for export was essential, and the high yields per acre of cotton, compared with those of other countries, pointed to cotton as the most suitable crop to fill the gap.

In 1919 a Brazilian Commercial Mission came to Europe to interest the European cotton-spinning industry in Brazilian cotton, and as a result an International Cotton Mission visited the country as the guests of the Government. In 1921 this Mission made a prolonged tour by rail, car, river-boat and horseback of some 7,500 miles through the cotton-growing states of São Paulo, Minas Geraes, Bahia, Alagoas, Sergipe, Pernambuco, Parahyba and Rio Grande del Norte. (The remaining states in the north, Piauhy, Ceara, Maranhão, Amazonas and Goyas, were visited by Mr. Arno S. Pearse, who wrote the accounts of both visits, in 1923.) These reports are as exhaustive as they are critical and although, as will be mentioned later, the emphasis on cotton has shifted from the northern districts to the São Paulo districts, some excerpts from the report are interesting when compared with the report of Mr. Norris (U.S.A.) to which reference is made later in this paper:

General.—" Hardly anything has been done to improve cotton cultivation in Brazil. . . . In almost every place I had to explain to planters, farmers, even to some cotton merchants, what constitutes the quality or value of cotton. . . . What Brazil has produced . . . has been achieved without the least human effort towards improvements. All is the spontaneous work of bountiful natural conditions. . . . Man has retarded, has persistently caused a deterioration of the cotton qualities, through laxity or ignorance, as for instance in the ginning and in the planting of mixed cotton seeds in the same field."

Yields.—" The yields per acre of lint in Brazil (especially in the state of São Paulo) are almost phenomenal. . . . Though it is difficult to obtain exact information as to yield in any country, especially when many cultivators cannot write, yields of 500 lb. of lint per acre in São Paulo and Rio Grande del Norte are no exception. Ceara, Parahyba and Bahia show frequently yields of 200 to 250 lb. Compare this with 90 lb. for India and 142 lb. for U.S.A. and bear in mind that the high yields in Brazil have been obtained without any aid, and you will realize what opportunities Brazil offers as regards cotton."

Types.—In Brazil there are two district zones. In the south or centre portion—(mainly São Paulo)—American Upland, planted annually, is grown with a staple of about $\frac{7}{8}$ inch to $1\frac{1}{8}$ inch. A mixture, in which the American type predominates, is grown in the states of Minas Geraes, Bahia, Alagoas, Sergipe and a part of Pernambuco. In Alagoas and Sergipe and in Maranhão only three months elapse between planting and picking. " There is no other country in the world where cotton can be grown in so short a period." In the northern states long-staple cotton is grown on trees which last for at least seven years and often longer.

Pests.—The bollweevil (*Anthonomus grandis*) does not exist in Brazil. The pink bollworm (*Platyedra gossypiella*), known locally as " lagarta rosada," and said to have been introduced about 1913 in a shipment of seed from Egypt, in 1919 devastated a large part of the crops, especially in São Paulo. Counter-measures, such as the use of fumigating chambers and disinfected seed, have been taken. Small cultivators employed a simpler method. " They spread out the seed to be planted in the midday sun for about three hours, at a temperature between 60° to 68°C. Some had mixed sand and also charcoal for the purpose of better retaining the heat." It was estimated that in this way 90 per cent. of the insects were killed.

Brazil, especially São Paulo, also suffers from the cotton worm

(*Alabama argillacea*), known locally as "Churuquerê," which feeds entirely on the young leaves and shoots. The Agricultural Department supplies large quantities of Paris green. If the plants are sprayed early, infestation does not develop as a rule in the south before the bolls are formed and begin to open. Once this stage has arrived it cannot do much damage.

The cotton aphis and ring worm in Brazil do rather less damage than in other cotton countries.

Seed.—At the end of the tour of the International Commission, Mr. Arno S. Pearse gave a synopsis of their impressions in a speech at Rio de Janeiro on August 16, 1921. He thanked their hosts, he praised their climate; he dilated on the possibilities for cotton, but he emphasized that their chance of creating a big export market in competition with other countries was negligible if they did not take trouble over classification by grower and merchant. "You have no cause to complain of any shortcomings of nature, but you must recognize the utter laxity displayed by those whose duty it is to grow and handle cotton. Once you have overcome your own personal shortcomings, there is no reason why Brazil should not become one of the largest sources of supply of cotton." He pointed out that practically no effort was made to separate the seed and three or four varieties were being grown together in one field, "with the result that picking gives short and long fibres, coarse and silky ones." He pointed out that if 20-mm. and 40-mm. fibres were mixed the price would be based on the 20-mm.; but, worse still, European buyers could never rely on uniformity in repeat orders. He recommended in the strongest possible terms the establishment of seed farms, owned or controlled by the Federal Government, for the production of seed best suited to the conditions of each zone.

These most forthright and frank reports of twenty-seven years ago had their effect. From 1930 onwards the surplus production of coffee all over the world made it increasingly difficult for Brazil to sell her coffee, while low prices were making it uneconomic to pick it. The Government, by various means, supported coffee prices, but at the same time adopted a policy of diversification of agriculture. In the state of São Paulo cotton became a substitute crop for coffee and, to ensure its adoption, the São Paulo Government not only established a special rate of exchange for cotton exports (to enable exporters of cotton to sell at the world price, while paying a higher price to the growers), but also, through a high tariff, was able to keep foreign textiles out of the country. Since about 1933 the local textile mills have supplied over 90 per cent. of the cotton goods in the country. The Government gave other encouragements. Loans were made to support the price and, indeed, at one time the Government itself became the owner of 200,000 bales. Cotton machinery was admitted free of duty. The results of this policy, as affecting São Paulo, are shown in the following table. The situation was, of course, intensified by closed export markets during the war.

São Paulo Cotton: Area, Production and Annual Yield,
1930-1 to 1948-9

Crop Year *August* 1-*July* 31	*Area* (*Acres*)	*Production* (*Bales of* 500 *lb. gross*)	*Yield* (*Pounds per acre*)
1930-1	148,260	48,427	156
1931-2	228,091	98,035	205
1932-3	299,379	160,262	256
1933-4	971,830	471,803	232
1934-5	1,355,416	452,944	180
1935-6	2,223,518	815,471	175
1936-7	2,587,343	934,501	184
1937-8	2,596,190	1,145,174	187
1938-9	2,230,401	1,260,330	185
1939-40	2,647,261	1,417,664	256
1940-1	2,742,130	1,756,148	306
1941-2	3,222,645	1,303,689	193
1942-3	3,280,252	1,730,002	252
1943-4	3,681,244	2,136,839	277
1944-5	3,789,054	1,073,124	135
1945-6	2,555,840	876,280	164
1946-7	3,137,394	804,932	123
1947-8	2,615,652	686,000	126
1948-9	2,088,000	964,931	222

These figures demonstrate the effect of the drive for cotton in the early thirties, assisted by the attraction to Brazilian cotton of foreign capital mainly from the U.S.A. and the Argentine. During the intervening period, however, production in the northern states decreased, and cotton in the south, mainly São Paulo, increased. Incidentally, considerable numbers of labourers followed cotton from the north to São Paulo. The following figures show the trend:

Cotton Production in São Paulo and Brazil
(500 lb. bales)

	1932/3	1937/8	1942/3	1943/4	1947/8
São Paulo ..	160,000	1,145,000	1,730,000	2,137,000	686,000
Total crop ..	481,000	2,075,000	2,172,000	2,700,000	1,260,000

The forecast for the 1948-9 crop is 965,000 bales from São Paulo out of 1,465,000 from all Brazil, while the good profits earned by farmers on this crop make it likely that the 1949-50 acreage, with normal conditions, will produce even better results.

Exports.—From 1930 onwards the export trade developed and flourished. The following figures are taken from the Economic and Financial Statistical Service, Ministry of Finance, Brazil. The São Paulo figures and the figures from other states are shown separately. (Bales of 500 lb. gross weight.)

Year	*São Paulo*	*Other States*	*Total*
Beginning Jan. 1			
1931	258	107,472	107,730
1936	610,762	470,322	1,081,084
1938	922,966	685,982	1,608,948
Beginning Aug. 1			
1940-1	1,150,441	182,097	1,332,538
1945-6	1,404,030	57,654	1,461,684
1947-8	924,670	124,459	1,049,129

Owing to closed export markets the war years are omitted. It is interesting to notice that the greater share of the export market now goes to São Paulo. British importers took 31 per cent. of all South American cotton sold abroad during the first half of 1949. Under the trade agreement with Brazil of August 5, 1949, Great Britain has agreed to take 280,000 bales of raw cotton besides some linters and waste.

Nearly thirty years have elapsed since the report of the International Commission and the speech of Mr. Arno Pearse at Rio. It is interesting to compare in detail some of the comments made by Mr. P. K. Norris, Agricultural Economist for the office of Foreign Agricultural Relations at Washington, who made a report in August, 1949.

Yields.—Referring to the table of acreage and production (page 94 above), Mr. Norris suggests that "the annual yields seem to follow a pattern or series of high and low years." In other words, "yields per acre influence to a considerable degree the area planted to cotton in the following year." This may be deduced from the figures, but the reduced acreage in recent years is probably due to a variety of causes:

(1) The increasing popularity of coffee, which has drawn labour from cotton in the São Paulo area.

(2) Speculation and the soil-wasting methods of cropping, From 1930 onwards there was a natural tendency to plant on new land—that is, land recently cleared of bush and scrub. As time went on, this land was overworked and growers tried out old coffee and other land which had been left derelict and subject to wind and water erosion. Little attempt was made to maintain and increase the fertility of the soil: indeed, fertilizers are almost unknown to the Brazilian cotton farmer.

(3) Moreover, as has happened in Africa, the chances of growing a crop which produced cash attracted growers to the detriment of the necessary food crops. Even in 1943 the Government started a campaign of "grow more food," very reminiscent of the campaign in this country, not to mention such countries as Tanganyika, during the war.

Pests.—There has been no diminution in insect pests since 1921. It is estimated that the pests may affect yield anything from 10 to 50 per cent. The pink bollworm is perhaps not so destructive as it was.

All seed is fumigated and in many places plants are destroyed in the field after harvest.

In São Paulo the cotton root borer (*Gasterocercodes brasiliensis*) is the most destructive pest. Burning plants after harvest, keeping the fields clean and rotating crops are all palliatives, but no effective method of control has yet been found.

The cotton leaf caterpillar (*Alabama argillacea*), referred to as the "cotton worm" by Mr. Pearse, is also a serious pest. The only form of control is spraying three times a year with calcium arsenate, lead arsenate, or other poison.

Seed.—It is always satisfactory when advice is taken. The authorities in 1921 took to heart the frank recommendations of the International Commission. Now, the standing of São Paulo cotton abroad is largely the result of controlled seed and gin supervision by the state.

In São Paulo seed production and distribution is under complete control by the state. The state makes contracts with growers for the varieties suitable to the local soil and climatic conditions; the seed is delivered to receiving centres, where it is tested for germination, cleaned, delinted and bagged. When it is distributed an interesting feature is introduced: the price includes a premium on a hail-insurance policy. In this way all the cotton acreage in São Paulo is covered by hail insurance. In São Paulo two varieties of cotton are being produced by the state authorities at the present time, both American Upland types with a staple $\frac{1}{16}$ either side of 1 inch. A third variety (Campinas 817), said to be superior to these, will be available in the near future.

The fact that all the seed is now state-controlled is of inestimable value. From the point of view of export it has ensured uniformity of type. It has done more: it has enabled São Paulo to compete on equal terms with U.S.A. cotton.

Types.—Careful classification is now carried out at the ginneries and at the port of shipment. From March to December, 1949, 81 per cent. of the cotton was either type 5 or type 5/6.

The Cotton Cultivator.— Mr. Norris's report emphasizes the primitive methods employed. Nearly all cotton growing is done, as in Africa, by the man with a hoe. "Most of the crop is planted by hand. . . . Usually one man makes a hole, a second man follows and drops the seeds, covering them with his foot. Generally the plants are from 30 to 40 inches apart in the rows and rows are 5 to 7 feet apart. The number of plants per acre is less than in U.S.A."

Excess plants are pulled out by hand, and cultivation is usually with the hoe, though one-row horse-drawn cultivators are beginning to come into use. It does not follow that the personal attention of the small cultivator does not produce at least as good a yield as crops produced by some form of mechanization, but, naturally, primitive methods must restrict the acreage. An improvement in this direction can only be gradual. In a recent report of the Joint Brazil-U.S.A. Technical Commission, set up in 1948 by the Brazil Government under the chairmanship of Mr. John Abbink (Chairman of the McGraw International Corporation of New York), it was stated that only 23 per cent. of the farms of Brazil possess any agricultural machinery, while, according to a census of 1940, in the whole country of 3,300,000 square miles there were then only 3,500 tractors in use.

Labour.—In Brazil labour is an uncertain quantity. It has been estimated that, out of the total population of 48 million, 30 million are employed in agriculture. It has also been estimated that at the peak of cotton production 400,000 persons were employed on cotton. This has now dropped to about 200,000. There are several reasons for this. Coffee is again a popular crop. Many of the small, struggling cotton cultivators, although in general they are said to be improvident, can do better by working on coffee fazenda until they can make sufficient to start again on their own. Then there is the call of the towns and cities. There are few amenities in the country. The housing is often primitive. The wages in towns may be four or five times as high as in the country (though, of course, the cost of living is equally high), but, as industrialization increases, the movement from the country to the town will increase. At the moment there is not only no unemployment, but there is not sufficient labour to go round. No wonder that the Abbink report stresses the need for sound plans to balance the agricultural and industrial economy. The situation will no doubt improve with the increase in immigration, the gradual advancement in mechanical methods of cultivation, and the gradual increase in rural education, but it is unfortunate that at the moment when there is a great demand for Brazil's principal exports there is not sufficient labour to produce any appreciable increase. From the cotton point of view it must be stated that, for the next few years, there is little chance of drawing any labour away from coffee. World consumption has exceeded world production and there can be no falling-off in the demand for Brazil coffee.

Lastly, the Land.—Much land in Brazil within a few hundred miles of the coast has been worked out, deserted and left to the elements. The centre of production is moving from the northern states to São Paulo. Even coffee is moving from the states of Espirito Santo and Rio to São Paulo. But it is not stopping there: both cotton and coffee are stretching out further south into Paraná, always seeking new, fertile land. But Brazil can no longer afford the traditional attitude that there will always be unlimited new land " beyond the frontier. . . . Brazil has never possessed large areas of level, fertile, easily subjugated agricultural lands such as the pampas of the Argentine or the steppes of the Ukraine or the mid-west plains of U.S.A. The cultivated lands now in production are Brazil's real, proven agricultural wealth" (Abbink report). Though further lands might be brought in or large irrigation projects started (*e.g.*, in the San Francisco river basin), it is not realistic to expect much increase in the present acreage of land for crops. Therefore, what is now necessary is the maintenance and restoration of soil fertility.

In the centre region, in the state of Rio, southern Minas, São Paulo and northern Paraná—which constitute two-thirds of the crop lands now under cultivation—soil fertility has declined sharply from its virgin state. Even in the higher cultivation areas, organic matter is burned out of the soil in a few years, and continuous cropping and leaching by heavy rainfall remove soluble plant food elements. Soil erosion, less advanced methods of cultivation, depletion of fertility through widespread coffee and cotton planting, lack of soil building crops and a very limited use of commercial fertilizers have taken a very heavy toll of Brazilian agriculture.

It is interesting to find the candid remarks and criticism of an International Commission in 1921 balanced by similar criticisms by a Brazil-U.S.A. Commission about agricultural organization in general in 1948. On this occasion the report does not criticize the action of the state organizations. They may be satisfactory and, from the action taken by the São Paulo state authorities in connection with cotton seed and cotton ginning, it may be assumed that in certain directions they are excellent, but this report deals with direction and control of agriculture generally. The last two pages are devoted to the organization of the Ministry of Agriculture. At this stage the U.S.A. Delegates, with great delicacy, stood back and allowed the Brazilian members to give their views. This they did with damning clarity. They presented a picture of an administrative bureaucracy without sufficient funds, without sufficient technicians and with little (or too much) organization: "The technical departments are subordinated to administrative departments with pitiful results. . . . These administrative departments have a delaying action. . . . The ever-increasing and overwhelming Brazilian bureaucracy causes more damage than erosion itself. And both of these are undermining our national wealth. . . . Freedom of action within practical limits and a true responsibility would defend public interests in a much better way than our network of bureaucratic prohibition." And so on.

The Summary makes suggestions for a new organization especially to deal with the expenditure proposed by the *Salte* plan, a five-year plan issued by the Brazilian Government in 1948 to deal with and improve the vital services of health, food, transport and power at a total cost of nearly 20 million cruzieros or about £259 million at pre-devaluation rate, but ends as follows: " We want to emphasize, however, that no plan will ever be carried out if the present administrative provisions are not modified."

It is abundantly clear that the Brazilian Government have great problems to face in the future, including the reorganization of some of their departments, but, from their action in the past two years, they have shown that they are not unaware of their difficulties. They have been broad-minded in again inviting the help of experts from another country. May their decisions be wise and their actions firm and drastic, so that the future of Brazil may be assured.

Outlook and Conclusion

What is the future for Brazilian cotton? Here we have a picture of a huge country with varying climates and, anyhow in São Paulo and Paraná, with ample rainfall and with conditions for cotton production equal to any rain-grown area in U.S.A.: a country with land not necessarily unlimited, but if reclaimed and properly farmed capable of increased production: a country where, with increasing population, domestic demand should continue to take care of at least 50 per cent. of any crop produced: a country where federal and state Governments are doing all they can to improve the agriculture of the country, are intent on increasing production and export, and are ready to assist the growers by every means available. With all this the prospects would appear favourable, subject always to the costs of production enabling Brazil to meet competition overseas and subject to the continuance of a stable labour supply.

Acknowledgments

The material and many quotations for this article are derived from—*Brazilian Cotton*, a report published in 1921 by Arno S. Pearse of the journey of the International Cotton Mission through the cotton states of São Paulo, Minas Geraes, Bahia, Alagoas, Sergipe, Pernambuco, Parahyba, Rio Grande do Norte. *Cotton in North Brazil*, by Arno S. Pearse, being the report published in 1923 of the journey through the states of Ceara, Maranhão and Para, together with a synopsis of the whole of Brazil's cotton potentialities. *São Paulo Cotton*, by P. K. Norris, agricultural economist, dated August, 1949, and published by the Office of Foreign Agricultural Relations, U.S. Department of Agriculture, Washington, D.C. *Report of Joint U.S.-Brazil Technical Commission* set up in 1948 under the chairmanship of Mr. John Abbink (Chairman of the McGraw-Hill International Corporation, New York). To all of these I tender my sincere acknowledgments.

Received January, **1950.**

AN ANALYSIS OF THE FACTORS WHICH GOVERN THE RESPONSE TO MANURING OF COTTON IN EGYPT*

BY

DAVID S. GRACIE

PART I

COTTON growing in Egypt has taken its present extension from the provision of a supply of summer water and the consequent change-over from the basin system of irrigation, with its single annual flooding, to free-flow perennial irrigation. Soil fertility could evidently be maintained indefinitely under the former system, but how permanent it may be under the more intensive cultivation as at present practised on perennial land is something that still remains to be seen. A study has been made in recent years of the changes going on in perennial land as compared with typical basin land (defined as " normal ") whereof these cotton experiments are illustrative; variation in the physical properties arising from these changes is reflected as variation in the level of yield of cotton; the latter in turn is the main factor controlling the response to fertilizer nitrogen, at least in so far as the Delta is concerned.

The distinction just made between the behaviour of cotton in Lower Egypt (the Delta) and in Upper (*i.e.*, Egypt south of Cairo) introduces a factor which is of importance second only to the physico-chemical properties of the soil in deciding what the result will be—namely, the variation in temperature experienced, whether geographically in moving from north to south through the cotton-growing area, or seasonally from year to year.

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* Being a summary of the information contained in—

1. " An Analysis of the Factors governing the Response to Manuring of Cotton in Egypt," by D. S. Gracie and F. Khalil in collaboration with H. Enan, *Tech. Bull. No.* 152, Min. of Agric., Egypt (1935).
2. " Les effets du sol, de la saison et de la fumure sur la vegetation et le rendement du cotonnier," *Bull. de l'Union des Agriculteurs d'Égypte*, March, 1939, No. 301. [D.S.G.]
3. " The Organic Content of Soils of the Middle East," by David S. Gracie. *Proc. of the Conference on Middle East Agric. Development*, p. 107 (1944).
4. " An Analysis of the Factors governing the Response to Manuring of Cotton in Egypt " [Continued], by David S. Gracie in collaboration with Hussein Enan, *Tech. Bull. No.* 152, Min. of Agric., Egypt (1949).
5. " Dibble-Sowing of Cotton, Method, Effects and Profits," by W. L. Balls and D. S. Gracie, *Tech. Bull. No.* 229, Min. of Agric., Egypt (1939).
6. " The Total and Available Phosphoric Acid in Egyptian Soils and the Effect of Superphosphate on the Main Agricultural Crops," by D. S. Gracie and F. Khalil, *Tech. Bull. No.* 251, Min. of Agric., Egypt (1948).

Our immediate concern here is the short-term one of obtaining the maximum benefit from fertilizer nitrogen; an understanding of the nature of the seasonal and climatic variation is therefore of great importance. Discussion consequently centres largely round temperature effects, and the essential background to it will be found in the two chapters on " Development and Environment " in *The Cotton Plant in Egypt*.* Mean monthly maximum temperatures have been employed for the most part for convenience as they give a better range (and soil temperatures are important), but it is of course actual minimum night temperatures that control the growth rate during the first half of the growing season. " The optimum temperature for growth is about 32° C.; tissue temperatures which exceed 38° C. reduce the subsequent growth of the cotton plant to a marked extent, while prolonged exposures above 35° C. are proportionately harmful " (W. L. B.).

The main conclusion that Dr. Balls drew from his observations was that " the author's colleague, Mr. F. Hughes, has shown conclusively that the cotton crop of latter-day Egypt is rarely limited—in Blackman's sense—by the chemical composition of the soil. Water, always sufficient, but never excessive, is the principal need of the crop." Level of yield is an expression of the water available, largely as decided by the physical properties of the soil, in conjunction with the temperature.

The weights and measures used in Egypt have been retained in this account, being convenient and easy. The " feddan " is an acre, the " rotl " a pound, and the " kantar " of seed cotton is equivalent to 100 lb. of lint cotton.

METHOD OF EXPERIMENTATION

The leading idea behind the field experiments was that, for each year, they should be sufficiently numerous and well-distributed throughout the country for the results to be capable of statistical analysis and to be representative of cotton growing in Egypt as it actually is. The variation due to soil, season and climate is such that isolated observations may be very misleading and can have little value; as much, if not more, emphasis is laid on the actual number of observations and on the length of time during which they are continued as on the accuracy of the individual experiment. The last has, however, in no way been neglected. The standard experiment from 1933 onwards employed five levels† of nitrogen and two levels† of superphosphate, giving in all ten treatments. The layout was in the form of six randomized blocks with plot size $\frac{1}{40}$ feddan, so that the results can be treated by the analysis of variance.* The superphosphate was worked into the south side of the ridge before sowing to be as near the seed as possible and the two smaller dressings of nitrogen given at thinning; the two larger nitrogen dressings were split, part at the rate of 200 kilos of fertilizer (2N) per feddan being given at thinning and the remainder at the next watering.† The fertilizer was applied in pinches just below the foot of the plants. The seed cotton harvested from the plots is weighed in rotls and the weights converted to kantars per feddan at the rate of 315 rotls a kantar‡. The yield figures used are based on the averages of twelve plots in the individual experiments—*i.e.*, they include half of any effect from superphosphate; compared with nitrogen yield effects from superphosphate are very small indeed.

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* *The Cotton Plant in Egypt*, by W. L. Balls. Macmillan and Co., 1912.

† 0N, 1N, 2N, 3N and 4N (1N means a dressing of a nitrogenous fertilizer supplying nitrogen at the rate of 15½ kilos per feddan). 0P and 2P (2P means 16-18 per cent. superphosphate at the rate of 200 kilos per feddan).

The manurial treatments apart, the instructions were that there should be no alteration in the practice of the farm on which an experiment was carried out, but that the details of that practice concerning sowing and picking dates, spacing, waterings, variety and previous crop should be recorded. The soil and climatic factors will vary from experiment to experiment and the seasonal factor from year to year. Pink bollworm cannot be avoided, but the few experiments in which the cotton was damaged by the cotton leafworm have been rejected. From 1935 onwards the soils of the experiments were sampled by taking a composite surface sample from the control plots and by sampling four successive layers of 25 cm. each from a hole dug to the depth of 1 metre just off the edge of the experiment. These soil samples were examined in the laboratory for available nitrogen and phosphoric acid and the results compared with the recorded yields.

The number of experiments was roughly thirty a year and the total carried out during the sixteen years from 1931 to 1946 was 491. They were designed by their number and distribution to sample the crop of each season, and the fact that they are a reasonable reflection of what happens in ordinary cultivation is shown by Fig. 1A and Fig. 1B, where the average yields (including the effect of 3N) in the experiments are compared with the average yields for all Egypt for each year of the experiments.

THE NATURE OF THE EFFECT OF TREATMENTS

Benefit from fertilizer nitrogen depends partly on its effect in increasing the number of early bolls and partly on the extent to which it is possible to pick the late bolls formed as the result of its use. The desirable thing is to increase the former as much as possible, since

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* *The Arrangement of Field Experiments and the Statistical Reduction of the Results*, R. A. Fisher and J. Wishart. Imp. Bureau of Soil Science, Tech. Comm. No. 10 (1930).

† But see later under "Available Soil Nitrogen."

‡ A feddan is an acre, nearly. One kantar of seed cotton = 315 rotls, equivalent to 100 rotls lint cotton; 100 rotls = 99 lb. approx.

COMPARISON OF YIELDS IN EXPERIMENTS WITH AVERAGE YIELDS FOR ALL EGYPT

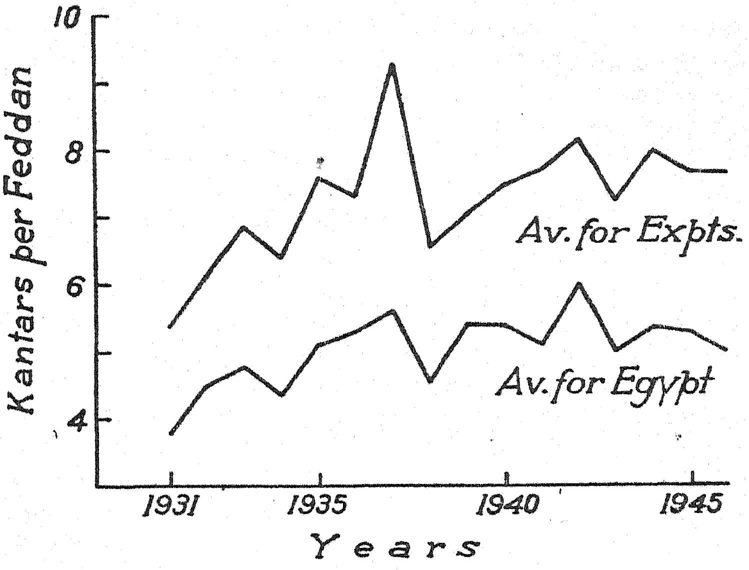

FIG. 1A.

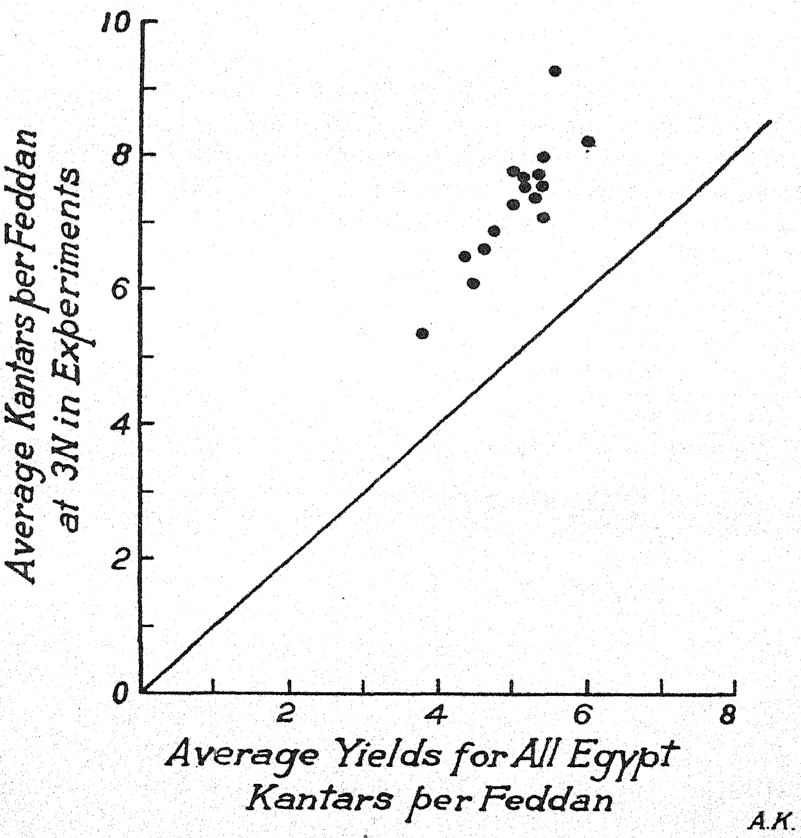

FIG. 1B.

there will be shown to be a large element of speculation about the late-formed bolls, quite apart from the certainty of their being attacked by the pink bollworm. The main source of information about the effect of treatments comes from the fact that the crop has generally been gathered in two pickings which have been separately weighed and recorded so that any alteration caused by manuring upon the proportion of the crop at the second picking can be followed. Where the effect of a treatment is to cause an increase or amplification of the initial rise in the flowering and bolling curves, the early bolls will be mainly affected, and the proportion of the crop at the second picking will remain the same or even diminish. On the other hand, where the same treatment in another experiment results in a deformation or prolongation of the flowering and bolling curves, owing to increased vegetative growth, the proportion of the crop obtained at the second picking will increase to a greater or less extent irrespective of whether the total yield is increased or not.* In this latter case, although the total positive effect experienced in the yield may be considerable, the nature of the reaction must be sharply distinguished from the former and the nitrogen (or other) factor causing it cannot be regarded as a limiting one in the same sense.

AVERAGE EFFECTS FROM NITROGEN

The sixteen years' average, eliminating seasonal effect, for control plot yield and increases from nitrogen, together with the shifts in the proportion at the second picking associated with these increases, are given below separately for Upper Egypt and the Delta.

AVERAGE EFFECTS FROM NITROGEN

Region	*Number of Experiments*	*Average control plot yield*	*Average total increases:*			
			0-1N	0-2N	0-3N	0-4N
(a) Kantars per feddan						
Upper Egypt	173	6·05	1·00	1·60	1·96	(2·19)
Delta	318	5·54	0·77	1·20	1·46	(1·66)

(b) Proportions of crop at second picking

	No. of Expts. with a SecondPicking					
Upper Egypt	126		1·2	2·9	4·6	
Delta	278		2·1	4·2	6·1	

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* It should clearly be recognized that nitrogen can be taken up without there being any corresponding increase in yield.

Increase in yield from nitrogen in the Delta is on the whole more dependent on picking the late bolls than in Upper Egypt and dependence in the Delta itself is in turn greater in the north than in the south; the proportion of experiments in which a second picking was not worth while is highest (27 per cent.) in Upper Egypt; the Delta experiments can be split up to show that those with only one picking (13 per cent.) occur in the south and that two pickings are the invariable rule in the north.

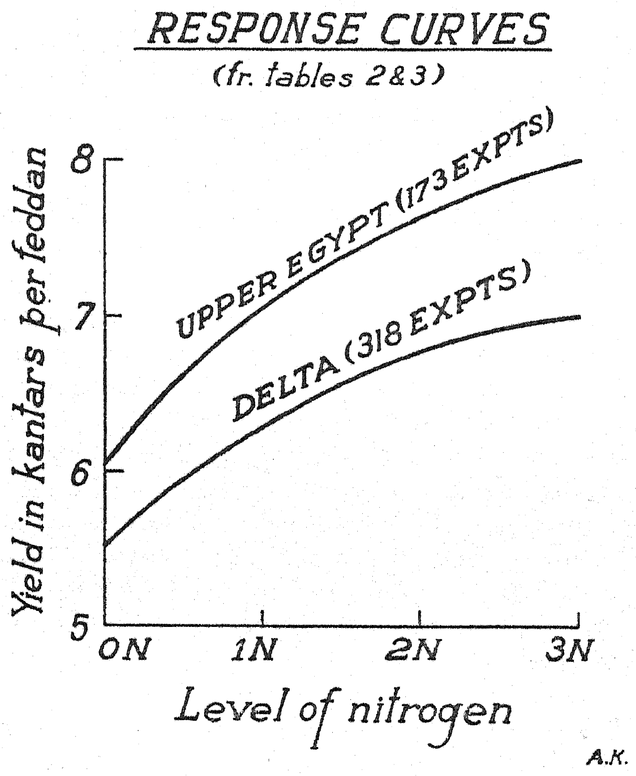

FIG 2.

The larger return from fertilizer nitrogen in Upper Egypt as compared with Lower, therefore, comes with the early bolls and will be shown to arise from the higher temperatures of the growing season in the southern region; control plot yields are also higher there on the average, but even in the four years when this was not the case benefit from fertilizer remained superior. The response curves for the two regions, drawn from the averages in the table, are given in Fig. 2; the difference in favour of Upper Egypt is $\frac{1}{4}$ kantar per feddan at 1N, increasing to $\frac{1}{2}$ kantar at 3N.

YIELD EFFECTS FROM NITROGEN AND THE EARLY AND LATE BOLLS

Superimposed on these variations in relative effect on early and late bolls according to climate are equally marked ones due to season. But it is a notable fact that, during the first five years (dealing now with the experiments as a whole), the considerable fluctuations in yield effects from nitrogen depended almost entirely on the extent to which it was possible to pick the late bolls, with the effect on early bolls tending to be constant. When the increases in yield are plotted against the associated increases in the proportion at the second picking for these five years, as in Fig. 3A, the points tend to group themselves about a single straight line, since the essential difference between them is the length to which a line of points is prolonged—*i.e.*, the number of late bolls picked; the year 1939 has been included in the diagram as being similar to the other five. To complete the picture the results for the six years have therefore been averaged and entered as the central straight line in Fig. 3B with the points for the years 1936, 1937 and 1940 lying above it and those for 1938 below it. Two effects are apparent in this second diagram: the length to which a line of points is prolonged continues as before to represent the number of late bolls picked, while the direction which it takes reflects the effect on the early bolls. Thus the effect on the latter was at a minimum in the cold spring of 1938 and at a maximum in the warm ones of 1936 and 1937, and the marked difference in yield effects between the last two years is owing to the fact that fewer late bolls were picked in 1936 than in 1937. The fact that it was not until the experiments were in their sixth year that marked stimulation of early boll production became a possibility in the Delta, and not until their eighth year that a really cold spring was encountered, is the reason why emphasis was laid on the length of time during which it is necessary to carry on with field experiments if conclusions of any value are to be made.

The late bolls of Upper and Lower Egypt have been dealt with together here for the sake of convenience in illustration, but when the conditions controlling their production and survival come to be considered, the two regions must be treated independently; a year in which late bolls are picked in Upper Egypt may be a poor one for them in the Delta, and *vice versa.*

LEVEL OF YIELD

An even more fundamental aspect than that of either seasonal or climatic variation is brought out by the series of parallel lines obtained when yields are plotted against treatments for individual experiments with any one variety in any one of certain years (see Fig. 4). This parallelism means that factors other than fertilizers dominate the

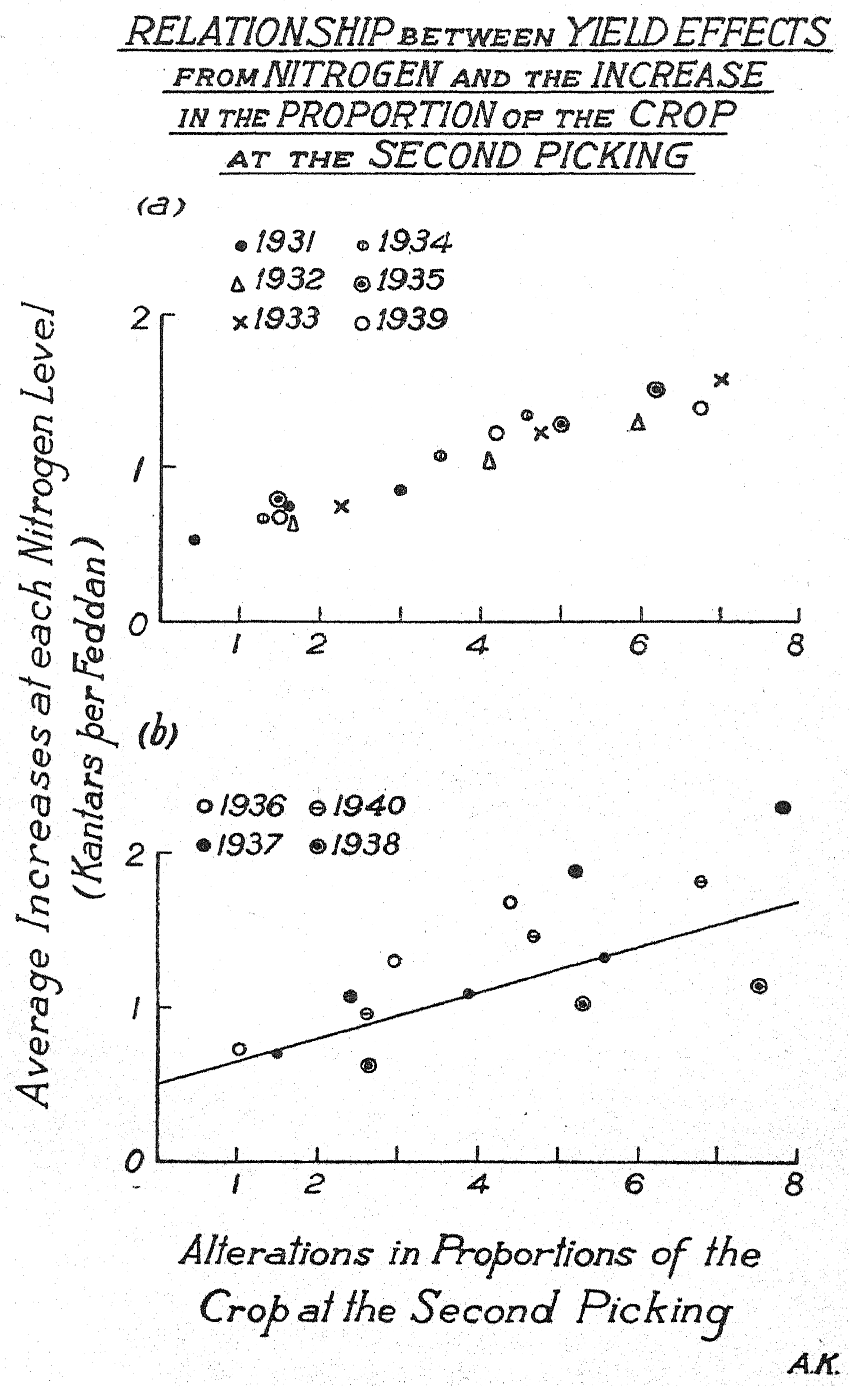
RELATIONSHIP BETWEEN YIELD EFFECTS FROM NITROGEN AND THE INCREASE IN THE PROPORTION OF THE CROP AT THE SECOND PICKING
(a)
● 1931
⊕ 1934
△ 1932
◉ 1935
× 1933
○ 1939
2
1
0
1
2
4
6
8
(b)
○ 1936
⊖ 1940
● 1937
◉ 1938
2
1
0
1
2
4
6
8
Average Increases at each Nitrogen Level (Kantars per Feddan)
Alterations in Proportions of the Crop at the Second Picking
A.K.

Fig. 3.

situation and determine the level of yield and that nitrogen, whether already present in the soil or added as manure, can in general only act within the limits imposed by these other factors. Level of yield is best regarded as being in the main an expression of soil quality and in particular of those properties determining the water intake of the root system, but factors such as irrigation practice and spacing also make important contributions. In the Delta in addition it actually decides what the degree of response to added nitrogen will be (the responses are higher at the higher levels), so that it forms the natural basis of classification of the results later under "Practical Application."

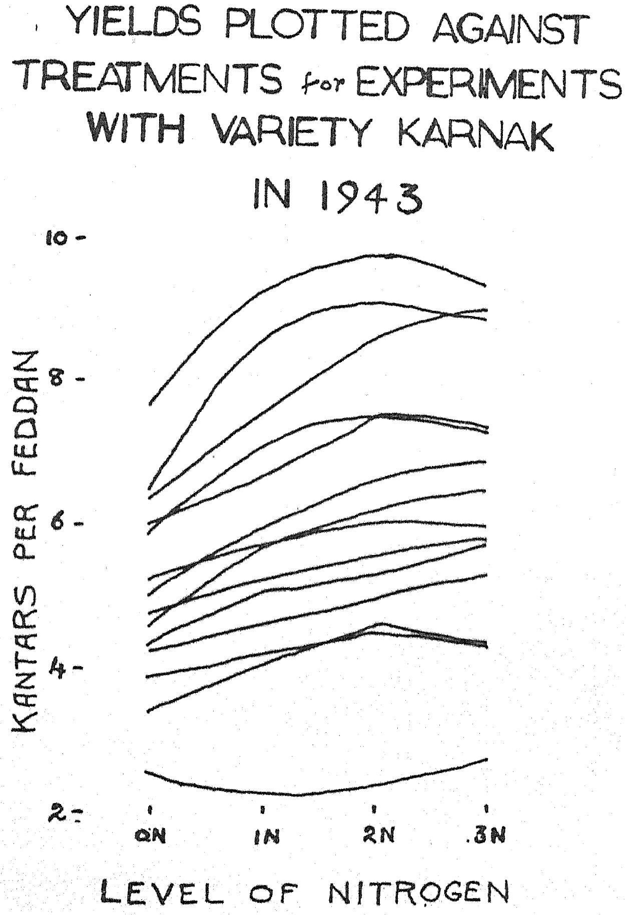

Fig. 4

The parallelism of Fig. 4 could be reproduced many times; it was a regular feature of the experiments during the first five years, when the effect of fertilizer on the early bolls tended to be constant. It was broken in 1936, the first year in which marked stimulation of early boll production by nitrogen was possible in the Delta, when the lines for some experiments in which nitrogen had exerted an unusually large effect crossed many of the others; and the distinguishing feature of these exceptional experiments was that in them advantage had been taken of the favourable conditions to sow early.

INFLUENCE OF SOWING DATE

The nature of the seasonal effect as regards the early bolls is best appreciated by the consideration of the relationships between sowing date, control plot yield and maximum increases* from nitrogen, both within the individual experiments for any one year and between their seasonal averages. Tables 1 and 2 give the average values for these features and the total correlations which have been calculated between them, respectively for the experiments in Upper Egypt and in the Delta. The average maximum and minimum temperatures for the months of February to August inclusive for the two stations of Minia and Assiut in Upper Egypt and for the three stations of Tanta, Zagazig and Giza in the Delta for the sixteen years covered by the experiments are given in Table 3. The figures illustrate the temperature gradient that extends during the cotton-growing season from the Mediterranean southwards to Asswan. The whole area is under the same climatic

TABLE 1

UPPER EGYPT

Year	*No. of Experiments*	*No. after bersim*	*Average Sowing Date* I	*Av. Control Plot Yield (k.p.f.)* II	*Average Maximum Increase (k.p.f.)* III	*Total Correlations between:*		
						I *and* II	I *and* III	II *and* III
1931	8	—	8/3	5·05	1·10	—	—	—
1932	16	2	7/3	4·90	1·99	±·00	—·07	—·16
1933	10	2	28/2	5·94	2·15	+·14	+·26	+·65*
1934	7	1	3/3	5·81	2·21	—	—	—
1935	4	1	22/2	7·25	2·48	—	—	—
1936	8	1	27/2	6·86	1·99	—	—	—
1937	9	1	27/2	7·91	2·92	—·20	—·15	—·38
1938	10	1	27/2	6·43	1·52	+·21	—·22	—·41
1939	6	—	1/3	5·56	1·67	—	—	—
1940	14	1	3/3	5·36	2·67	±·00	—·54*	—·45
1941	14	1	24/2	5·40	2·30	+·02	—·40	—·28
1942	13	2	3/3	5·92	2·66	+·23	—·50	—·33
1943	13	4	5/3	6·04	3·15	—·16	—·55*	—·49
1944	14	6	10/3	6·10	2·31	+·02	—·20	—·64*
1945	14	4	12/3	5·60	2·75	—·42	—·25	—·29
1946	13	3	6/3	6·95	2·50	+·28	—·18	—·32

* The correlation is significant at 20:1

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* The maximum increases over the control plot yields have been taken out irrespective of the nitrogen level at which they occur; their averages are therefore rather higher than those for the increases at 3N as such.

influences, so that the higher mean monthly temperatures for Upper Egypt show a very close correspondence with the lower ones recorded farther north.

TABLE 2

DELTA

Year	*No. of Experiments*	*Average Sowing Date* I	*Average Control Plot Yield (k.p.f.)* II	*Average Maximum Increase (k.p.f.)* III	*Total Correlation between:* I and II	I and III	II and III
1931	15	11/3	4·36	0·88	—·52*	—·26	—·25
1932	26	15/3	4·68	1·17	—·38*	—·04	+·31
1933	19	12/3	4·93	1·45	—·64*	—·40	+·41
1934	18	10/3	4·86	1·66	—·25	—·25	+·14
1935	21	3/3	5·79	1·61	—·01	+·04	+·08
1936	27	10/3	5·41	2·00	—·11	—·62*	—·06
1937	20	7/3	6·56	2·66	—·16	—·57*	—·26
1938	21	9/3	5·04	1·22	—·57*	—·25	+·15
1939	16	14/3	5·87	1·58	—·60*	+·22	—·49*
1940	22	13/3	5·86	1·76	—·30	—·01	+·20
1941	21	8/3	6·15	1·94	—·51*	+·21	—·53*
1942	15	11/3	6·06	2·25	—·20	+·15	+·21
1943	20	14/3	5·03	1·52	—·30	—·47*	+·74*
1944	16	13/3	6·57	1·57	—·70*	—·16	+·16
1945	20	12/3	6·05	1·63	—·05	+·59*	+·02
1946	21	11/3	5·34	1·97	—·55*	+·40	—·19

* The correlation is significant at 20:1

[A similar table for the Delta experiments north of latitude 30° 45′ has been omitted.]

TABLE 3

MEAN MAXIMUM AND MINIMUM TEMPERATURES (°C.) FOR THE SIXTEEN-YEAR PERIOD 1931-1946

(*a*) Upper Egypt (Average of Minia and Assiut)
(*b*) Delta (Average of Tanta, Zagazig and Giza)

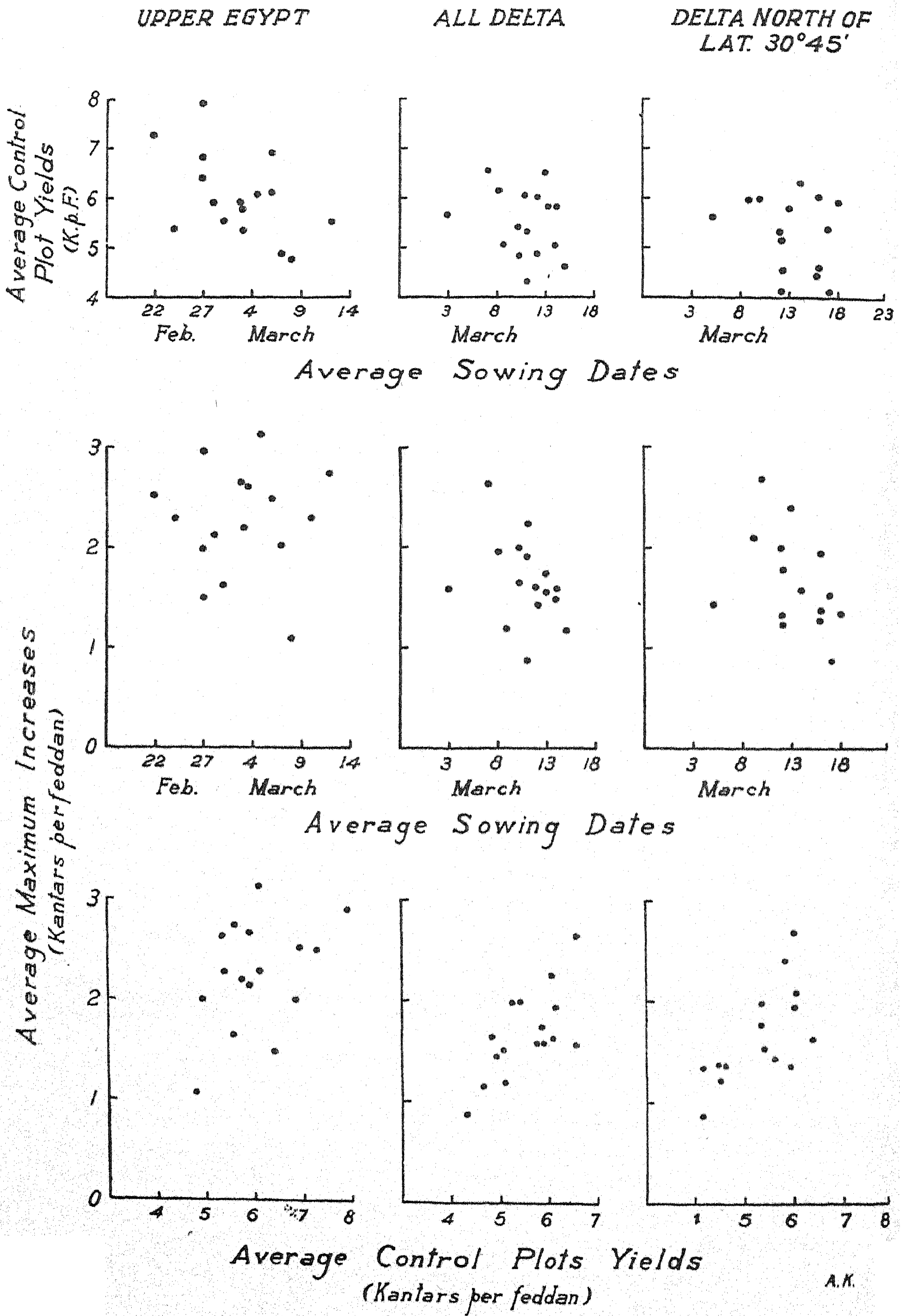
	February		*March*		*April*		*May*		*June*		*July*		*August*	
	Max.	*Min.*	*Max.*	*Min.*	*Max.*	*Min.*	*Max.*	*Min.*	*Max.*	*Min.*	*Max.*	*Min.*	*Max.*	*Min.*
(*a*)	22·4	7·3	26·0	9·9	31·0	13·9	35·6	18·6	36·8	20·5	37·0	21·8	36·7	22·0
(*b*)	21·4	6·4	23·9	8·3	28·2	11·0	32·2	15·0	34·4	17·8	35·2	19·7	34·7	19·8

The hottest months of the period were in Upper Egypt in May, 1941, and June, 1933, when the mean maximum temperatures were 39·9 and 39·6° C. respectively. The month of May in the Delta was warmest in 1935, 1939 and 1941, with mean temperatures respectively of 33·8, 34·1 and 35·5° C. The month of March was coldest in 1938, 1943 and 1945, when the mean maximum temperatures recorded for the Delta were respectively 21·5, 21·7 and 20·8° C.

In Upper Egypt the control plot yields in individual experiments are indifferent to the dates on which they were sown. Benefit from added nitrogen (*i.e.*, maximum increase), on the other hand, is consistently greater (negative correlations) on early sown cotton and where a low content of available nitrogen in the soil has limited the control plot yield. The only exception to this was in 1933, when benefit tended to be greater with the later sowings and was significantly so on higher yielding land (positive correlations); this reversal of usual behaviour is probably connected with the fact that the month of June in 1933 in Upper Egypt was easily the hottest of the sixteen years, and it is reasonable to suppose that the cotton on the better soils would more easily withstand the strain.

The indifference shown in Upper Egypt by the control plot yields in individual experiments to the dates on which they were sown does not extend to the Delta; there is a constant emphasis there on the need for early sowing to secure high control plot yield, the (negative) association being significant in eight years out of sixteen, although in some years it has a very low value. It remains almost as consistently negative in the northern half of the Delta, changing only in 1932 and especially in 1934, when the month of February was unusually cold, and later sowing than usual therefore desirable. In direct contrast also to what is found in Upper Egypt there are no consistent relationships between sowing date and increase from nitrogen, or between the latter and control plot yield; they may be positive or negative according to season. What will be termed the " normal " expectation in the Delta is fulfilled when both yield without manure and increase from its use are sufficiently dependent on earliness in sowing as to render the connection between the two positive; high response to nitrogen in individual experiments then tends to be associated with land that is already high yielding, although reaching actual significance once only, in 1943. An entire reversal of the normal expectation occurred in the Delta as a whole in 1939 and 1941, when low-yielding land gave the (significantly) better response, while the fact that the late-sown cotton benefited most from nitrogen in 1945 and 1946 meant its reversal, in so far as the northern half of the region was concerned. The departures from the " normal " can be associated with particular aspects of the seasons in which they occur, and fall to be dealt with more fully below.

When the average results for each season are considered there is a notable change-over in the emphasis of sowing date as between the two regions. In upper Egypt average control plot yield then shows a fair degree of dependence on earliness in sowing, while the connection between benefit from nitrogen and average sowing date becomes negligible; conversely the emphasis of earliness in the Delta is strongest on maximum increase and that on average control plot yield by contrast weaker, although it is still in evidence (see Fig. 5). The best expression of the seasonal effect is consequently found in the relationship between control plot yield and returns from fertilizer; these increase and decrease together in both regions, but in a more marked manner in the Delta, since the possibilities there are more restricted in any season



RELATIONSHIPS BETWEEN AVERAGE SOWING DATES AVERAGE CONTROL PLOT YIELDS AND AVERAGE MAXIMUM INCREASES FROM NITROGEN

FIG. 5.

(Fig. 5). The fact that large returns from fertilizer nitrogen can only be expected where a high level of yield already exists is a main conclusion from the experiments.

Sowing Date and Spring Temperatures

These variations in the influence of sowing date according to season and locality are in reality a reflection of the temperatures experienced in the early part of the growing season. They are illustrated in Fig. 6, where the control plot yields and maximum increases from nitrogen have been plotted against the dates of sowing for individual experiments in the Delta for the years 1933, 1936, 1937, 1938 and 1946. The mean maximum temperatures for the month of March are given at the top of the diagram as well as the average maximum increases from manuring in kantars per feddan. Marked stimulation of early boll production in the Delta is only possible in years such as 1936 and 1937, in which March temperatures are high and the weather in the months following reasonably satisfactory; the amount of stimulation possible (it varies from less than 1 to over 4 kantars) is determined by the extent to which advantage has been taken of these higher temperatures, as represented by the sowing date. Where spring temperatures are lower, owing to the slower growth rate, the possibility of such stimulation is diminished, and date of sowing becomes important mainly for control plot yield.

Similar considerations apply to Upper Egypt. Temperatures being higher, there is, on the whole, more latitude as regards time of sowing in any season, and a consequent relative indifference of the control plot yields to the dates on which they are sown in the experiments within any one year. Correspondingly, early sowing becomes important for return from nitrogen and the latter has a greater effect on yield in Upper than in Lower Egypt.

There is a well-marked optimum sowing date which gets steadily earlier as one moves from north to south, but which will of course at any one locality vary from year to year according to season. The average sowing dates employed in the sixteen years of the experiments are March 13 in the northern half of the Delta, March 10 for the Delta as a whole, and March 3 in Upper Egypt.* Fig. 7 shows that the limits to earliness in sowing in Upper Egypt are set in practice by the mean minimum temperatures in February.

Factors Affecting the Late Bolls

While the extent to which nitrogen can affect early boll production is controlled by the temperatures of the first part of the growing season,

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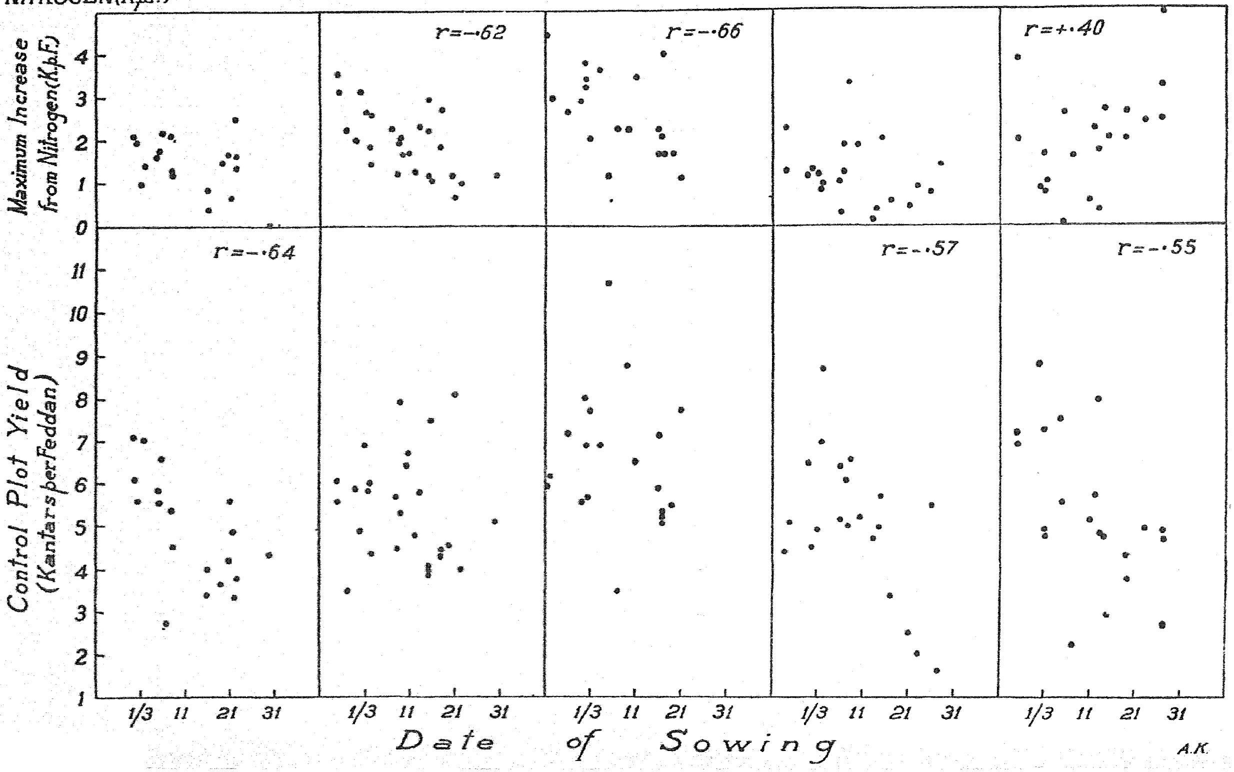
* No special benefit was derived in the Delta from the very early sowings of 1935. The month of April as well as May was unusually warm in that year.

Fig. 6.

RELATIONSHIP BETWEEN SOWING DATE CONTROL PLOT YIELDS AND MAXIMUM INCREASES FROM NITROGEN IN DELTA

YEAR	1933	1936	1937	1938	1946
MEAN MAX. TEMP. IN MARCH (°C)	23·5	25·1	25·5	21·5	23·9
AV. MAX. INCREASE FROM NITROGEN (K.p.F.)	1·45	2·00	2·66	1·22	1·97



the number of late bolls picked is largely decided by the temperatures in late summer.

The direct connection in the Delta between the mean maximum August temperatures and the number of late bolls harvested is shown in Fig. 8; excessive heat in that month causes undue shedding. The maximum temperatures in July also have some influence, and the point displaced to the left in the diagram is for 1936 when the second half of that month was very hot.

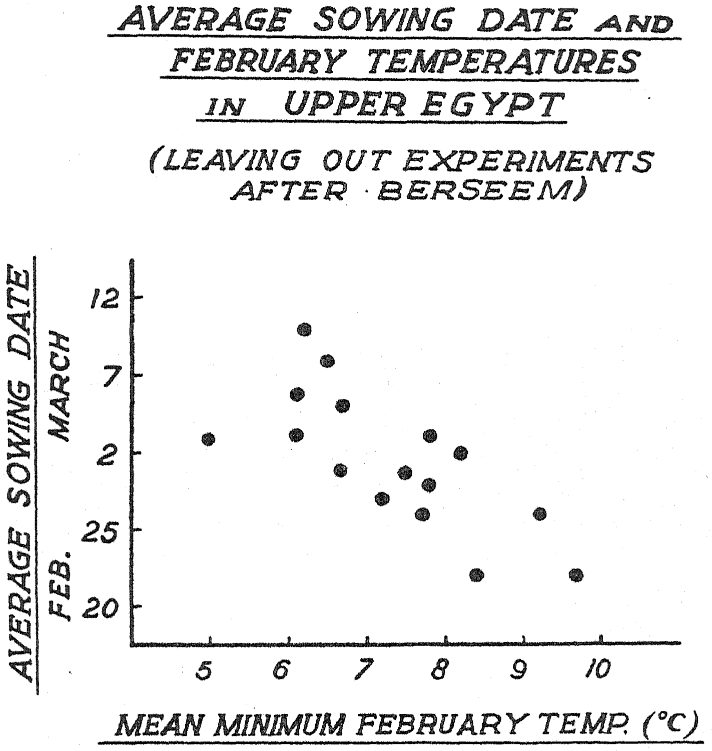
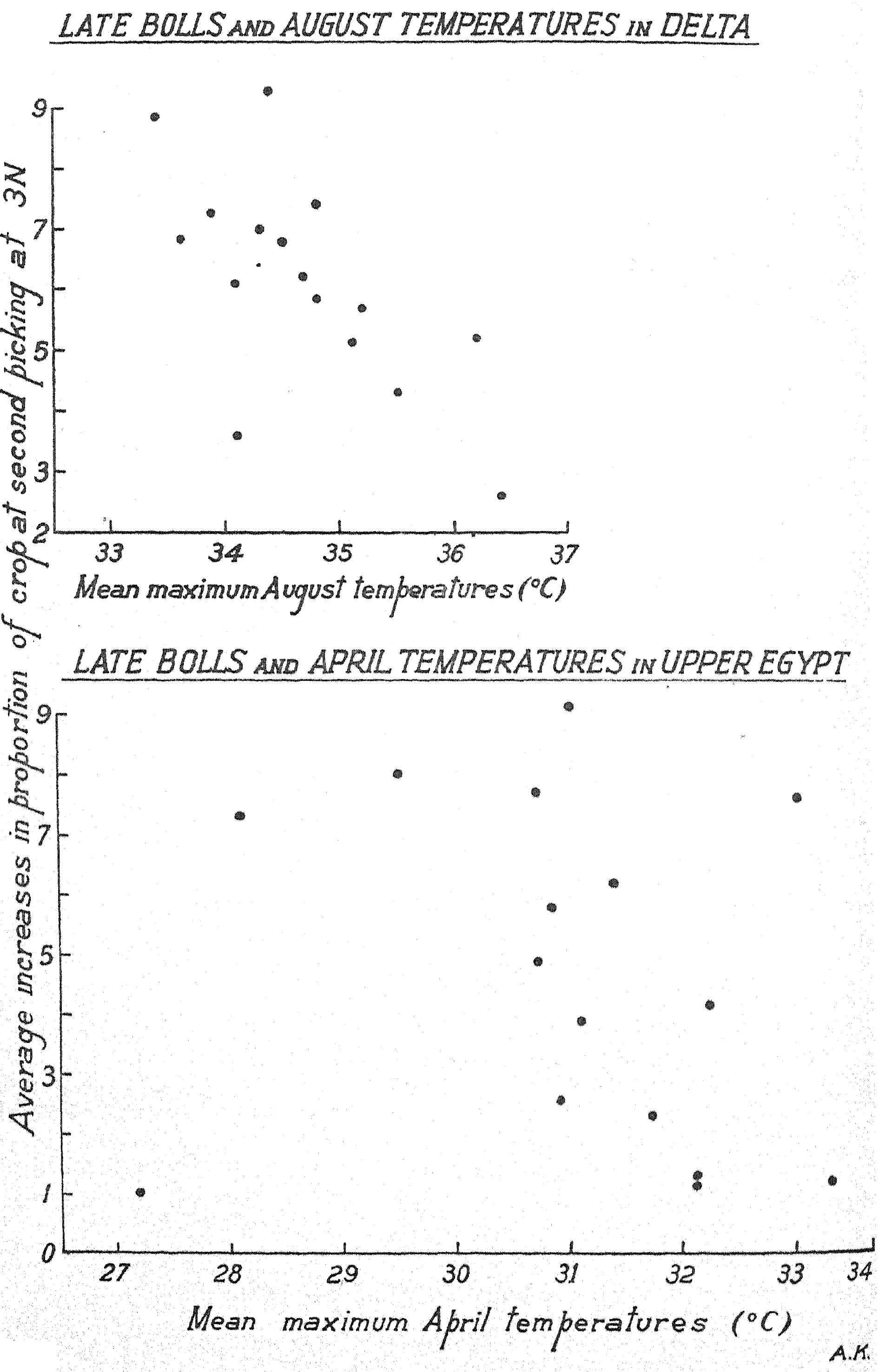


FIG. 7.

By comparison with the Delta any summer in Upper Egypt is hot, and yield effects from nitrogen in consequence less dependent on picking the late bolls. This temperature gradient provides the reason why the proportion of experiments in which a second picking was not worth while is highest in Upper Egypt and that, in the Delta, those with one picking occur in the south while two pickings are almost the invariable rule in the north. The number of late bolls that are picked in Upper Egypt depends, in part at least, on what conditions were like earlier in the season; Fig. 8 shows that where growth has been restricted by low temperatures in April there is a tendency for it to be prolonged.



LATE BOLLS AND AUGUST TEMPERATURES IN DELTA

LATE BOLLS AND APRIL TEMPERATURES IN UPPER EGYPT

Fig. 8.

SEASONAL EFFECTS IN GENERAL

Temperatures have been treated arbitrarily as above purely for the sake of convenience in discussion; it is obvious that each season should be treated separately as a whole. The number of late bolls which can be picked in Upper Egypt, for example, has just been shown to depend in part on the growing weather in April, but no similar relationship has been established between the temperatures in that month and production in Upper Egypt as a whole. In the same way a large return from nitrogen in the Delta can only be obtained if the weather in March is suitable, but it does not necessarily follow if that condition alone is satisfied. The most favourable March temperatures of the series in the Delta occurred in 1931 and were succeeded by very suitable months of April, May and June. The crop in that year with its enlarged vegetative growth then passed into the hottest (combined) months of July and August out of the sixteen years in a condition in which it was least able to withstand them; the severe water strain and heat injury resulted in such abnormal shedding that both control plot yield and return from manure were the lowest experienced. These adverse conditions may have been aggravated by a shortage of summer water,* but this cannot be verified for the experiments themselves as no records were kept of the irrigation practice in them for that year. The year 1937 provides the ideal season; March temperatures were almost as favourable as in 1931, but as conditions thereafter were in no way extreme the crop matured and was picked, so that the best return from manure and the highest total production were both recorded in the experiments for that year.

The " normal " expectation in the Delta that early-sown cotton will benefit most from fertilizer nitrogen is upset if the weather in May is unsuitable. Late-sown cotton responded best in 1945 and 1946 because it escaped the effects of the heavy and unusual rainstorms that marked that month in these years. In the Delta as a whole, however, low-yielding land as such gave a definitely better response only in 1939 and 1941. The interpretation of this result is ambiguous; on the one hand it can be attributed to the exceptional heat in May in the two years having interfered with the normal development of early plants, and on the other to the unusually low amounts of " soluble " nitrogen in the soils at thinning time, which may have meant that response to fertilizer was more conditioned by deficiency in that element than by anything else. But the amounts of soluble (ammoniacal and nitrate) nitrogen present at thinning will themselves be shown to be an expression of the temperatures experienced and to be low where these have been high.

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* The area allowed under rice in 1931 was very small at 65,000 feddans against 470,000 in the following year, which implies insufficient water.

The month of March was coldest in 1938, 1943 and 1945. In 1938 and 1943 the consequent restriction of growth resulted in low control plot yields and returns from manure in the Delta, offering in 1938 a most disconcerting contrast to the excellent season of 1937 that preceded it. In 1945, when March temperatures were lowest, some compensation was obtained from a warmer May than in the other two years, so that the final result was better.

(*To be concluded in the July issue.*)

SOME OBSERVATIONS ON THE ROOT DEVELOPMENT OF TREE-COTTON IN YUNNAN

BY

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ALTHOUGH the tree-cotton has been cultivated for ten years in Kaiyuan, Yunnan, its physiological and morphological aspects have been little investigated up to the present. The perennial habit of the tree under the influence of the climatic conditions in Yunnan, which are characterized by alternate dry and rainy seasons, each covering about six months, provides us with problems that would not arise or could not be thoroughly explored on annual cottons. It is the purpose of this paper to lay a brick on this foundation as well as to discuss some practical considerations.

Ever since the first day of tree-cotton extension, great care has been exercised in digging the planting hole. In the pamphlet *Tree-cotton Culture*[1] it is recommended that the hole should be 50 cm. in diameter and depth. This is a task, however, more easily set than carried out, and on a mow ($\frac{1}{6}$ acre) of average soil it takes five to seven days of labour to accomplish the work. The cost of this item alone accounts for one-fifth to one-fourth of the total expenditures in the first year, or one and a half times the land rent.

In 1944 Mr. Yang of this station planted several rows of tree-cotton without digging holes, and during all the subsequent years these trees have grown so well that one cannot distinguish them from trees grown in typical hills. People engaged in the extension work also ascertained that a few farmers grew their tree-cotton successfully without hard digging. We were therefore prompted to make an examination of the possible effect of hole-digging on the root system of cotton trees.

MATERIALS AND METHODS

The root systems of two plants were exposed and studied. The first plant was sown in 1944 and the second one a year earlier. Both were grown on red loam soil, but the ground where the second plant stood was pebbly at the surface, while gravelly concretions formed several layers of hardpan throughout the entire depth. The latter site was chosen on purpose to see whether the roots could penetrate these layers.

The first plant was excavated in January, 1948, and the second in September. Our tools consisted of pick mattock, grub hoe, sickle and chisel, and occasionally a spraying machine was used. The roots were traced carefully as far as possible and the larger ones drawn on section paper, but to different scales for the two plants.

It must be mentioned here that none of the tap roots could be traced to the end, owing to the difficulties in working at a depth of over 12 feet.

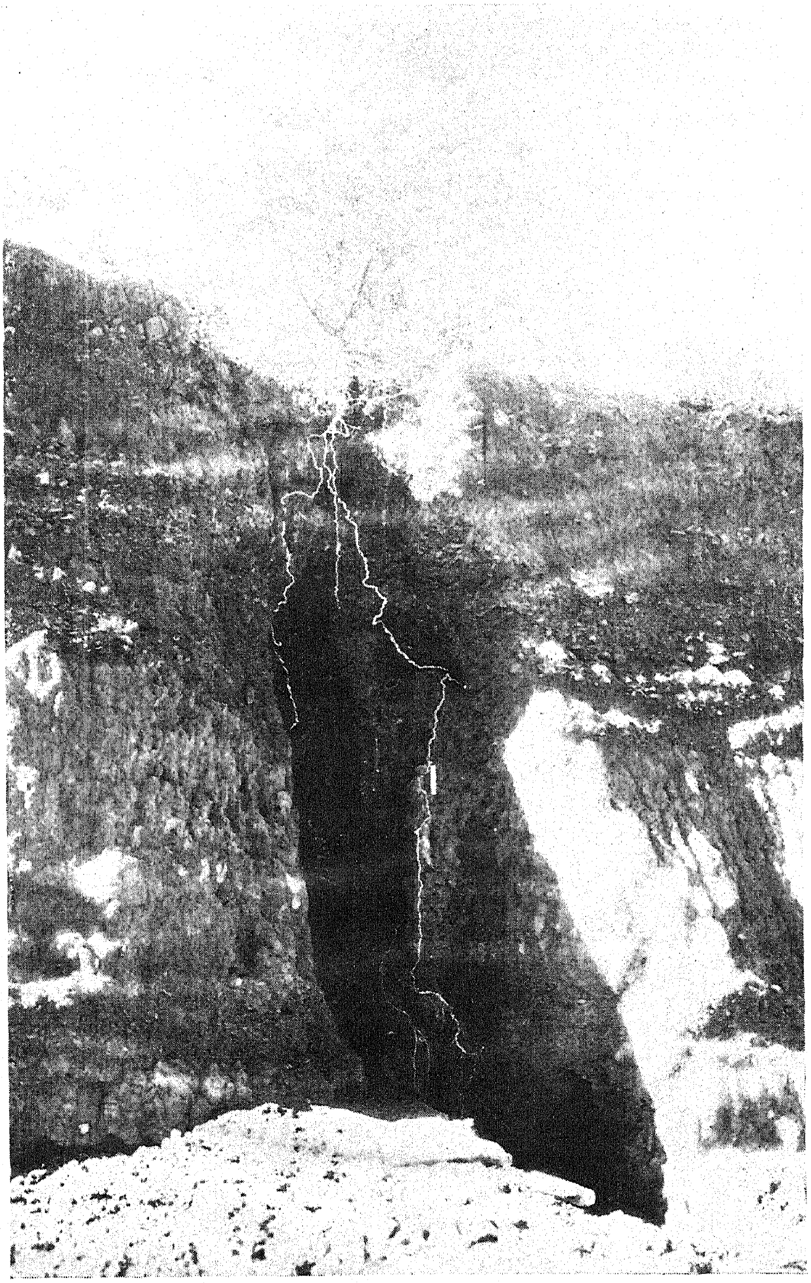
RESULTS

The tap root penetration

The plants studied were of good growth and Plate 1 shows the general features of the second plant.

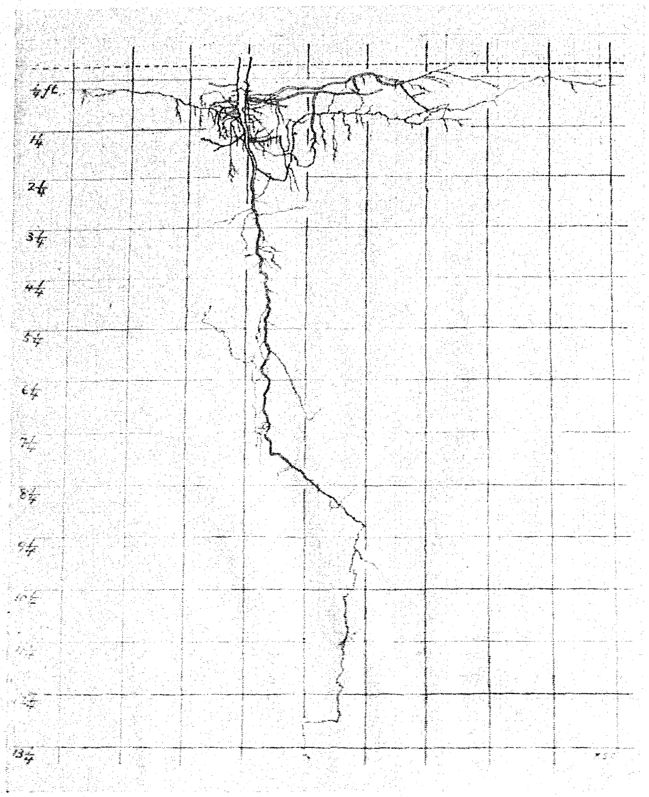
The tap root of plant 1 was traced to a depth of 13 feet 3 inches and its diameter at the point of breakage here was 2·5 mm. On the whole, roots of the first plant were much thicker than those of the second one. At 4 feet beneath the surface the main axis of the first had a diameter of about 1·1 cm. and at 8 feet about 4 mm., while at the same levels the tap root of the second plant had diameters of about 6 mm. and 3 mm. respectively. Twelve feet from the ground line the second plant had roots of 2 to 2·5 mm. in diameter, and 3 feet further down about 1·6 mm., which was the magnitude found by Brown[2] on Upland cotton plants 2 feet beneath the surface. The greatest depth reached by cotton roots hitherto reported is 10 feet 8 inches, which King[4] found on a Pima Egyptian. But, judging from our limited experience, we are fully convinced that for the perennial tree-cotton the tap root can easily attain a depth of 15 feet, and a maximum penetration of 18 to 20 feet is not altogether impossible.

The fashion of the tap root growth differed somewhat with the two plants. The first one was situated in deep soil with very little gravel. Its main root ran almost straight downwards, then obliquely a little way in the 8-foot interval, and after that it went down vertically again. The tap root of the second plant, however, was much contorted as may be seen from Plate 3. The zigzag course is taken as a result of the succession of hardpans. The first of these occurred a few inches beneath the soil surface and its thickness was a little less than 1 foot. The root there, however, was fairly straight, probably due to the influence of the hole dug for planting. A little way below the root became staggered, and at the region between 120 and 240 cm., where two layers of hardpan occurred, the root was much contorted. In struggling through the two pans, one 50 cm. and the other 40 cm. in thickness, the tap root was frequently squeezed flat. But its success in penetrating them was by no means a chance effect, since one of the branch roots passed through these layers also.



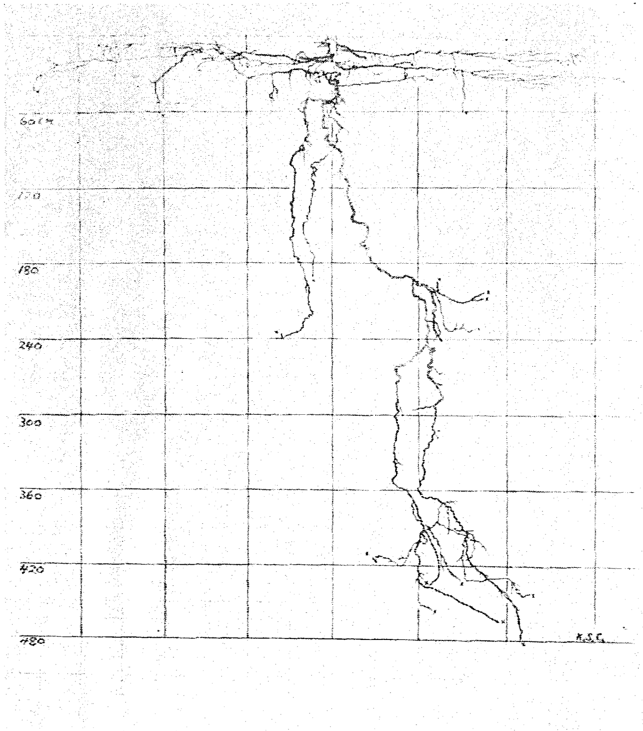
A PLANT OF TREE-COTTON, SHOWING ROOT PENETRATION; THE LITTLE RULE IN THE MIDDLE IS SIX INCHES LONG.

PLATE II



ROOT SYSTEM OF TREE-COTTON, THE FIRST PLANT.

PLATE III



ROOT SYSTEM OF TREE-COTTON, THE SECOND PLANT.

From 240 to 360 cm. the soil was of a uniform texture and not so stony. Here the roots assumed a practically vertical position, and at the 360 cm. level they pushed through another layer of hardpan about 8 inches thick. Soil below this layer was of a purplish colour, moist and apparently fertile, and within this zone the roots sent forth several branches. A hardpan of 1 foot thickness followed this bed of good soil, but the roots forced their way through it as well, though they were then so slender as to be only 2 mm. in diameter. At a depth of 450 cm. all roots turned obliquely downwards and to the inner side. The excavation work was then made so difficult that the roots were cut off incessantly and we were forced to give up. But the vigorous growth and the great depth that can be attained by the roots of the tree-cotton plant are clearly seen from the above descriptions.

As already mentioned, the root of the second plant appeared much more slender than that of the first. Whether it was due to the gravelly nature of the soil or not requires further investigation, but it was of interest to see that pebbles and small stones seemed to have something to do with the branching of roots. The tap root of plant 2 branched more freely in the gravelly soil, and it was often seen that two branching roots embraced a pebble at the point of bifurcation. Presumably roots may be capable of adjusting themselves when blocked in the line of elongation and can finger forth in more than one direction.

On both plants a few laterals were found to turn upward in the deep soil for reasons unknown.

The lateral spread

Tree-cotton is usually planted at a distance of 6 × 8 chih (1 chih = ⅓ m.). Main laterals reaching 2 m. in length were of common occurrence and some of them ran horizontally up to a distance of 9 feet. Most of them sprang from the main axis above the 1-foot level. On the plants observed there were no more than ten big laterals, all rebranched more or less, and some of them ran so close to the surface that in places they were less than 3 inches under the ground. They occupied an area within 1 to 1½ feet from the soil surface, and owing to the wide spacing no "pot-bound effect"[3] was evident as is shown in Plates 2 and 3.

Just under the trees, dense networks of roots ramified in the soil, especially where fertilizers had been applied. Residues of the oil cake have been seen much resembling in appearance the skeleton of a loofah. This is, however, the usual way root systems develop, and in our opinion it was more the result of plant habit and the location of fertilizer than of the loosening of the soil from digging. Once a lateral was traced to the adjacent hill and it was found there to have a bunch of fibrous roots on the fertilizer material.

The two plants showed a similar habit in their lateral roots, only more laterals of the second plant were found to grow downward. In Plate 3 points where the roots were not extensively traced on are marked with a " ×." But we may not depart far from the facts in saying that the main feeding area of the roots of tree-cotton is in the upper 2 feet and extends outward more than 3 feet on each side.

Weeds seemed to have some effect on root development. On the left of plant 1 there was a piece of uncultivated land and on this side the roots were less abundant—a fact which for the present we can attribute to no other cause.

Summary and Discussion

Tree-cotton growing under Kaiyuan soil and moisture conditions has a vertical penetration of over 15 feet, while a maximum of 18 to 20 feet is quite probable. The tap roots make stout growth in the soil and may pass through several layers of hardpan varying from 1 to 3 feet in thickness.

The results of these observations and some successful instances in level planting all showed that digging a large hole as previously recommended is certainly unnecessary. It would be more profitable to cut down this expense and use the money thus saved to hire land which is more fertile and will therefore produce a better crop, or in some other effective way.

Soil conditions greatly affect the root system. With a deep soil of uniform texture the tap root grows almost vertically downwards, while a gravelly hardpan makes it pursue a zigzag course and appear much compressed at times. Small stones, however, may exert some influence in promoting the development of branch roots and a moist fertile layer even of considerable depth may induce more.

The outward spread of roots usually exceeds 6 feet and extends sometimes to 9 feet or more. Nearly all of them run close to the surface, and on account of the wide spacing only a few of them grow appreciably downwards. The important feeding area therefore lies in the upper 2 feet, and a good surface soil is likely to be more effective than a localized planting hole.

The development of laterals is checked to a certain extent by the presence of weeds, and fertilizer concentration will lead to a dense network of slender absorbing roots.

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Received December, 1949.

A NOTE ON SOME GEOGRAPHICAL RACES OF ASIATIC COTTONS

BY

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1. Introduction

The most comprehensive account of intra-specific differentiation in a cultivated species of cotton is Silow's (1944) account of the geographical races of *G. arboreum*. He showed that though there are no sub-specific groupings sufficiently distinct to allow of a convenient classification into botanical varieties, differentiation in each of the main areas in which the species is distributed has given rise to a series of genetically distinct races. Silow's account of the species can now be amplified in respect of its African forms.

In *G. herbaceum* a greater degree of morphological differentiation is to be found, and the species has been divided into the typical form and two varieties. It has now become evident, however, that *G. herbaceum* is naturally divisible into five races, each occupying a distinct geographical area. The former threefold classification covers the major morphological distinctions, but is too incomplete to be worth retaining. A fresh account of the forms of *G. herbaceum* is given below, in which Silow's treatment of *G. arboreum* is followed, and the five distinct types are described as geographical races.

2. The African Races of G. arboreum

Of the African races of *G. arboreum*, Silow (1944) stated that " both genetically and taxonomically they are the least known of the *arboreum* cottons." Since his account was written a larger and more representative series of African types has been received, and opportunities for field study have also arisen. It is now evident that the old-established *arboreums* of Africa are all perennials. They fall into two distinct groups, and on morphological grounds the name *soudanense* should be confined to those of the Sudan and West African region. Those of Madagascar and the East African coast, on the other hand, resemble those of western India, and may be included with the perennial forms that comprise the primitive component of Silow's race *indicum*. These two races may be described as follows:

1. race *soudanense*. The Senaar tree cotton. Large perennial shrubs or small trees, often with trunks up to 3 inches in diameter.

Young, well-grown plants pyramidal, with long, ascending, slender vegetative branches. Twigs and leaves glabrous or only sparsely hairy. Anthocyanin pigment in stems, petioles and leaf veins strongly developed. In West Africa, types with full red leaves and red flowers predominate. Seeds small, often with green fuzz. Lint rather scanty, coarse or moderately fine, white, rarely light brown.

Distribution: The Sudan and West African region.

2. race *indicum*. Rounded, much branched perennial bushes (Rozi and the African forms), or small, almost unbranched, annual subshrubs (the commercial strains of Peninsular India). Twigs and leaves densely or (rarely) sparsely hairy. Anthocyanin pigment weak or absent. Red-leaved forms unknown. Lint white, scanty and coarse on perennial forms, of good quality on annuals.

   Distribution: The perennial Rozi cotton of Western India and the perennial *arboreums* of Madagascar and coastal Tanganyika. Received from Madagascar under the name of *G. mahafalense*. Formerly cultivated on the Zambesi and Shire rivers as far inland as Lake Nyasa. The annual commercial *arboreums* of Peninsular India.

3. The Differentiation of G. herbaceum

The area of greatest variability of *G. herbaceum* is in Baluchistan, Iran, Afghanistan and Russian Turkestan. Primitive perennial types still persist in the Mekran of Baluchistan (Ansari, 1941), but most of the region has cold winters, and is only suitable for the cultivation of annuals. It was here that annual cottons were first developed. They spread widely in south central Asia, and were also carried to areas beyond, where they have given rise to two other annual races. North-eastward, in Sinkiang and western Kansu, their establishment resulted in the development of the earliest cottons known. Southward, with the recognition in India of the value of the annual habit, the Indian *herbaceum* crop grew up following the introduction of seed from the north. Seed cotton was sent from southern Iran and Baluchistan to western India for ginning until a few years ago, and no doubt small quantities of seed occasionally escaped into the Indian crop.

Apart from the Mekran types, and one from Cyprus, perennial forms of *G. herbaceum* are now only to be found in Africa. They exist in two distinct and widely separated areas, the bushveld region of southern Africa in the south, and the savannahs of the Sudan and West African region in the north. The origin of the southern form is uncertain, but though it now only survives in the wild, evidence has been given (Quintanilha *et al.*, 1948) for the belief that it was formerly cultivated. The northern form appears to have been introduced by the Moslems from

Arabia, and to have been carried by them via the Egyptian and Libyan oases to the West African savannahs (Hutchinson, 1949).

Except for a trifling infiltration of seed from Iran and Baluchistan into the Indian crop, isolation between the five areas occupied by *G. herbaceum* appears to be complete. This is in contrast to the situation in *G. arboreum,* in which contact between neighbouring geographical races is generally sufficient to allow of considerable gene exchange in border regions. It is reflected in a greater morphological differentiation between races, though they do not differ enough to render identification easy in all cases.

The recognition of five geographical races is a simple amplification of the division of the species into a type and two varieties (Hutchinson, 1947). The typical form is divided into two, the central type of Iran and the neighbouring countries (race *persicum*) and the small, early cottons of western China (race *kuljianum*). The present var. *acerifolium* is divided into race *acerifolium* in Africa and race *wightianum* in India. The South African form, race *africanum,* remains unchanged. These five races may be described as follows:

1. race *persicum.* The typical form of *G. herbaceum.* The Levant cotton of Watt (1907). Small, annual sub-shrubs, with stiff stems and few or no vegetative branches. Twigs and leaves sparsely hairy or glabrous. Leaves large, almost fleshy, very broad lobed (not more than half cut), flat. Bolls usually rather large and round, sometimes tapered and prominently shouldered; pale green, generally only cracking and remaining closed when ripe, sometimes opening widely. Seeds large, fuzzy. Lint copious, and of fair quality.

   Distribution: Iran and Baluchistan, Afghanistan, Russian Turkestan, Iraq, Syria, Turkey, Greece and the Mediterranean islands. It was widely spread round the Mediterranean by the Moslem invasion (Watt, 1907) and was the earliest cotton cultivated in the Nile delta in Egypt (Dudgeon, 1917).
2. race *kuljianum.* The *G. herbaceum* var. *kuljianum* of Russian workers. Very small, annual sub-shrubs with slender stems and few or no vegetative branches. Fruiting branches developed very early. Twigs and leaves sparsely hairy or glabrous. Leaves small, broad, flat. Bolls small, tapered, with prominent shoulders, opening widely when ripe. Seeds few, small, fuzzy. Lint scanty and of low quality.

   Distribution: Sinkiang and western Kansu, China.
3. race *acerifolium.* *G. punctatum* var. *acerifolium* of Guillermin and Perrottet (1830), *sensu strictu.* Large, rounded perennial shrubs with stout stems and many vegetative branches. Twigs and

leaves usually densely, sometimes sparsely, hairy. Leaves not large, usually about two-thirds cut into five lobes, thick and rumpled. Bolls rather small, almost parallel sided, with prominent shoulders, opening widely when ripe. Seeds small, fuzzy. Lint usually rather scanty, coarse.

Distribution: North Africa south of the Sahara, from Abyssinia to the Gambia, and the desert oases of Egypt and Libya. Saudi Yemen, Arabia.

4. race *wightianum*. *G. obtusifolium* var. *wightianum* of Watt (1907) (in part). Large annual shrubs with stout stems and usually several vegetative branches. Twigs and leaves densely hairy. Leaves rather large, usually about two-thirds cut into five lobes, thick and rumpled. Bolls rather large, almost parallel sided, with prominent shoulders, opening widely when ripe or (in the Wagad variety) cracking and remaining closed. Seeds fairly large, fuzzy. Lint copious, of good quality.

   Distribution: Western India from Cutch to Madras.

5. race *africanum*. *G. herbaceum* var. *africanum* H. and G. Bushy shrub with many thin vegetative branches, glabrous or finely tomentose on the young parts. Leaves thin, flat, with the lobes rounded, deeply constricted at the base, sinuses between the lobes open. Bolls small, rounded, opening widely when ripe. Lint scanty and of poor quality.

   Distribution: Portuguese East Africa south of the Save river, the Low Veld of the Transvaal, Swaziland and Southern Rhodesia, and sporadically across the continent to Angola and South-west Africa. Formerly occurring as far north as the Zambesi (see Hutchinson, 1949).

4. Discussion

The interpretation of the evolution of *Gossypium* in terms of geographical distribution is now carried a stage further. Silow's (1944) account of *G. arboreum* is completed, and it is shown that sub-specific differentiation by local selection has gone on in *G. herbaceum* as well as *G. arboreum*, and that the situation in the two species differs solely in the more complete isolation of the *herbaceum* areas.

The derivation of four of the five races of *G. herbaceum* can be inferred with confidence. From a primitive perennial of which the Mekran *herbaceums* are the nearest modern representatives, race *acerifolium* was derived direct by westward migration, largely—at least in the later stages—in the hands of the Moslems. Race *persicum* was developed in Iran and Afghanistan by selection for the annual habit in the old perennial stock, and the success of the newly bred annual *persicums* led to spread into Sinkiang in the north-east, where selection for earliness was carried even further, and into India in the south, where the demands of Indian commerce led to the development of the best quality types in the species.

The relationship of race *africanum* to the rest of the species is obscure. Though now to be found only in the wild, it appears to have been cultivated at one time, and since it does not differ more from race *acerifolium* than the latter does from other races of the species, it is reasonable to suppose that it has not been in isolation much longer than its immediate relatives.

5. Summary

1. The perennial forms of *G. arboreum* in Africa are assigned to two races, race *soudanense* in the Sudan and West Africa and race *indicum* on the East African coast and in Madagascar.

2. *G. herbaceum* is classified into five races, race *persicum* in south central Asia, race *kuljianum* in Chinese central Asia, race *acerifolium* in north Africa and Arabia, race *wightianum* in western India, and race *africanum* in south Africa.

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Received December 1949.

MISSION TO CHINA

BY

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PART II

In China my wife and I spent much time in the universities, many of which are located on a spacious campus with well-cut lawns, flower beds, wooded areas, streams and lakes. The buildings are of particular interest to "foreigners," as we soon came to know ourselves in that country. A few university departments are housed in converted palaces or temple quarters, and naturally enough these do not often prove particularly suitable as science laboratories. Probably the majority of college buildings are a compromise between the functional design of the West and the traditional and beautiful architecture of the East, with its graceful curving line of roof and liberal incorporation of colour and fanciful ornamentation. Thus a rather plain rectangular building, somewhat Georgian in style, may be surmounted by a curved roof like that of the old imperial palaces, with tiles of vivid green or blue, and generous overhanging eaves carrying gargoyles and other symbolic features at the corners. In the interior the ceilings of the main entrance and reception halls are ornamented with richly coloured designs, usually geometric in conception. On the other hand, many buildings are purely functional in design, most modern in character, and carried out in ferro-concrete. Set amidst the undoubtedly more romantic architecture of the East, these Western buildings often look very much out of place, but they are likely to increase in number, for they are more practical and their original cost and maintenance lower than that of part-Chinese-style buildings.

Universities in China are large, with a student body of anything up to five or seven thousand. Damage to educational institutions in China as a result of the Sino-Japanese war, in buildings and equipment, has been estimated at about 250 million pounds sterling. Probably at least half of the Chinese institutions of higher learning are located in the Peking, Nanking and Shanghai areas, and it was in these areas that the greatest losses were suffered through hostilities. Add to this the fact that the present student enrolment is frequently of the order of some five times that of pre-war days—in Britain it has risen by only 50 per cent.—and it will be realized that the Chinese universities are suffering acutely from congestion. This is aggravated by the fact that most are fully residential. The active rehabilitation and expansion of facilities which have marked the past three years in spite of the background of most disheartening inflation, are a great credit to the Ministry of Education and the university administrations concerned, though naturally in the circumstances a very great deal remains to be done.

Modern higher education in China is still extremely young. A very few of the forerunners of the present universities have existed for some eighty or ninety years, and some have a much longer history, but until thirty or forty years ago all of their teaching was strictly in the traditional style, restricted largely to the study of the Chinese classics and the art of fighting. An unwilling recognition only of the existence of an outside world was made in the study of foreign languages, amongst which English, French and Russian were most favoured. It was not until the Nationalist Government became established in Nanking in the middle 1920s that a determined country-wide effort was made by the Chinese themselves to disseminate modern higher education throughout China. Under the direction of that Government there was remarkable progress in the development of higher institutions of learning, especially in the decade from 1927 until 1937, when the Government had to move to the interior before the Japanese advance.

Western higher education was brought to China partly by the few Chinese who went abroad to study, and partly by missionaries of many denominations. The missionary contribution, especially from the early years of the present century onwards, has been of inestimable value to China. In particular the missionary universities have provided locally, on the spot, an example of the kind of organization required—examples, for the benefit of government officials and public-spirited benefactors, of something for which there was no precedent in the country. There are now some fourteen Christian universities in China, one of them operated by the Roman Catholics and the other thirteen by a united board of various associated Protestant denominations. Eight of the latter have strong contacts with Britain, and come under the ægis of the China Christian Universities Association, whose aim it is to interest people in this country in them and secure much-needed support for their continued maintenance. Their success derives largely, I consider, from the breadth of vision with which the field workers have approached their task. There is no undue emphasis on sectarian matters, and by no means all of the enrolled students are professed Christians. It is by precept rather than by forced teaching that the Christian outlook is fostered, although of course religion has its place in the curriculum. Character-building is emphasized rather than academic achievement, and the education given is intended primarily to be of practical value to the Chinese in the further development of their country, and to provide a background of enlightened public conscience to work for the amelioration of their appalling social conditions. Nevertheless academic standards are of the highest. Three of these Christian Union universities have outstanding reputations in medicine, one in dentistry, and two in pharmacy, whilst two others have turned out many of the country's leaders in the agricultural field. Whilst some of these institutions are in easily accessible cities in the coastal provinces, such as Peking, Nanking, Shanghai, Foochow and Canton, others are buried deep in the interior. Thus there is one at Tsinan, in war-torn and famine-stricken Shantung province, and another at Chengtu, in the heart of Szechwan province, more than a thousand miles from the coast. Such truly remarkable institutions are a tribute to the foresight, faith and dauntless courage of those pioneer men and women who, under very difficult circumstances, are bringing elementary and advanced education, and health and other social services to a backward and down-trodden peasantry. Journeys to these mission stations, which can now be accomplished in a few hours in the luxury of a Skymaster, only a few years ago entailed four or five months of arduous and hazardous travel from the coast. The example of selfless devotion shown by the missionary workers through long years of service cannot fail to be a source of courage and inspiration to the many Chinese people—including those who are not Christian—who are struggling to improve the lot of their fellow-countrymen. In addition to all this, the Christian universities, where Britons, Canadians, New Zealanders, Americans and occasionally representatives of other countries may be seen working harmoniously together alongside their Chinese colleagues, provide a splendid working example of the type of co-operation which is so essential for international understanding and harmony.

During this same period that the missionary universities have developed to their present position, since the beginning of the century, the national educational system of China also has shown remarkable progress. There are now some thirty-one national institutions of full university status, and further nearly one hundred national, provincial and municipal smaller colleges and technical institutes providing, all told, for a number of students approaching one hundred thousand—which is approximately ten times the number in the missionary universities. In assessing the present standing of the Chinese universities it must be remembered that what has been attempted in China is to implant a totally alien system of education and belief into the midst of an ancient and highly organized culture. Small wonder, then, that those broadminded and progressive Chinese leaders who have been responsible for this innovation take such great pride as they do in their splendid achievements. In the decade before the Sino-Japanese war especially, the national universities caught up with the leading missionary universities in academic standing, and in some faculties, such as those of geology and mathematics, compared very favourably with Western universities. In China probably fully 80 per cent. of university students take scientific or technological courses, especially medicine, agriculture and engineering. This is an indication of the urgent seeking after the technical knowledge so much needed to improve their country. On the non-scientific side, by far the greater number pursue studies in economics or law. At present the actual number of students in China is only about the same as in Great Britain, though her total population is some ten times greater, but of the continuing insistent demand for higher education there can be no doubt. This is shown by the figures for the entrance examinations, which are organized by the universities themselves. Recently fifteen thousand students sat for the entrance examination to the National University of Peking, for only five hundred places available there. The demand for vacancies is just as great in the missionary universities, where almost all students pay a tuition and boarding fee, as it is in the national universities, where fully two-thirds of the students have free places. Thus at the missionary West China Union University at Chengtu in Szechwan province, right in the purely rural interior, there were six thousand candidates for only one hundred and fifty vacancies. This means that of every thirty or forty pupils leaving the middle schools who are anxious to continue their studies, only one is successful in gaining entrance to the universities. There is certain to be a very considerable increase in facilities for higher education in China in the near future, though the difficulty will be in finding a sufficient number of adequately qualified lecturers and professors, for the academic profession has held no particular attractions to young graduates in recent years and there are now serious difficulties in the group between the middle-aged and the totally inexperienced.

Most of the Chinese universities award only bachelor degrees. Of nearly fourteen hundred university departments in the country, only about one hundred and fifty have attached to them post-graduate research sections, and only a few of these award master degrees. No doctorate degrees have been awarded in China at all. Yet a doctorate degree is an almost essential qualification for appointment at the professorial level, or as departmental head, as well as for practically all senior civil service positions. Naturally therefore there is most intense competition for opportunities for post-graduate study abroad, especially for those which carry with them the possibility of working for a Ph.D. degree. Overseas scholarships and fellowships which make this possible are provided by many different bodies, including the Chinese Government itself, various missionary groups, educational foundations, several foreign universities, and various other groups interested in international cultural relations. Amongst these the British Council makes available to Chinese nationals about forty awards each year, available for study or for professional observation at British universities or research institutions for periods ranging from three months up to three years. Although awards from such organizations in total make a very substantial showing, probably by far the most significant contribution to the advancement of higher education in China has been through the overseas awards made possible by the return to China of the Boxer Indemnity Funds from various countries, including the United States, which is far in the lead so far as numbers are concerned, and Britain, France and Japan.

Modern university education in China today, which is so largely scientific and technical in nature, is to a very considerable extent superimposed upon a type of junior education which is little different in content and outlook from that of the old despotic Manchu days. There are still many influential representatives of the older generation who maintain that China has no need of modern industrial arts and developments. Education in China still unduly favours studies in language, literature, history, philosophy, political science and economics, to the disadvantage of pure and applied science. This is especially so at the pre-college level, in the elementary and secondary schools, which are still largely in the hands of the " elders " of the local community. It is only comparatively recently that the schools have come within the purview of the Ministry of Education, which was in fact formerly known as the Board of Universities. The broadening in scope only came just over twenty years ago, at the time when there was a comprehensive reorganization of various official departments in Nanking, when the Central Government was becoming firmly established after the successful conclusion of the northern campaigns against the war-lords remaining after the 1911 revolution. Ministry influence has not had time to penetrate very deeply into the schools, and the provision for scientific teaching and for laboratory experience in them still leaves very much to be desired. Probably thousands of young students enter their degree courses without ever having personally held a test-tube in their hands, and under the prevailing overcrowding in the universities very many graduates even at the end of a four-year course have had less individual practical experience in the laboratory than most youngsters leaving one of our better high schools in the Western countries. This lack of practical experience is aggravated by the fact that most young Chinese children have not got a home background where they can become acquainted with mechanical and scientific things as our youngsters can. This puts the adult world of Chinese science and technology at a very serious disadvantage, yet the achievements of those Chinese scientists who have acquired a sound scientific training shows hat the Chinese mind is inherently as capable in this sphere as is the mind of any Westerner. Rectification of the present top-heavy educational system, with official interest so largely confined to the university rather than the school level, should have the very highest priority in plans for the coming rehabilitation and modernization of China.

Following our visit to Peking, Shanghai became my base of operations. It is the hub of the communications system of China, and I found that there was a constant flow through it of people whom I needed to see, coming from and going to all parts of China and overseas. It is in addition one of the most important educational and scientific centres in the country. It is one of the leading medical training centres; there are several universities, many famous research institutes and dozens of chemical factories and industrial plants. During the period between the return of the Nationalist Government from Chungking to Nanking at the end of the war, and its recent withdrawal before the Communist armies, this lower Yangtze valley area was the most vital part of China, economically, culturally and scientifically. Now that the Communist Government has designated Peking as the capital there may well be a general revitalization of the north. The Peking-Tientsin area is very important industrially, and added to this are all the assets further north and in Manchuria, which at the time it was lost to Japan in 1931 contained 70 per cent. of China's industry.

From Shanghai we made frequent visits to Nanking, about 180 miles by rail, usually travelling by over-night sleeper. This railway, built and originally operated by British interests, is now managed entirely by the Chinese. The sleeping cars are as clean and comfortable as any in the world in which I have travelled, service is excellent, and the trains exceedingly punctual. The efficiency of such an undertaking as this railway is but one example from amongst many that could be brought forward to show that the Chinese people are inherently capable of effective administration and organization, notwithstanding what is so frequently said to the contrary. That China can make plans as well as carry them most effectively into operation is evident from the country-wide progress that was achieved in the decade before the opening of full-fledged hostilities by the Japanese in 1937. That decade is after all the only moderately peaceful period that China has had since the downfall of the Manchu régime in 1911. It was not until 1927 that the various ministries got effectively into operation, and the whole of China was consolidated under the Central Government at Nanking. During the following ten years great progress in the modernization of China was made, in spite of the growing menace of Japan from 1931 onwards. Then in 1937 the real blow fell, and appeasement was no longer possible. Since that time, notwithstanding the eventual defeat of Japan, China has known no peace. When at last she does have a period of stability there can be little doubt that she will have sufficient organizing ability and technical skill to put into effect the many social reforms and the industrial development for which she has been waiting so long.

Nanking itself is a much less attractive city than Peking. After passing through the impressive gates of this large walled city, it is a disappointment to see so many poor reproductions of Western suburban homes, and the standard of domestic architecture has not been raised by the recent ruling that owners of vacant land must build immediately or forfeit their holdings. It was a surprise to find so many acres of cultivated land within the city walls, and kitchen gardens and farm ponds so close beneath large and beautiful Chinese-style government buildings, but this is a relic of the way of providing against siege in the days before the advent of long-range artillery and the bombing aeroplane. The disappointment of the city of Nanking is, however, more than compensated by the charm of the surrounding countryside. The city is dominated by the aptly named and beautiful Purple Mountain, on whose crest gleams the modern observatory of the Institute of Astronomy of Academia Sinica, the Chinese National Academy. In the grounds of this Institute are now located some of the historically priceless Mongol astronomical instruments constructed during the thirteenth and fourteenth centuries for the observatory which still exists on the south-east corner of the city wall of Peking. These large instruments include various types of armillary spheres, mural quadrants, and apparatus for determining azimuths, and so on, all embellished with that fascinating ornamentation in the shape of life-size serpents and dragons so much associated with traditional Chinese art. On the far side of the Purple Mountain is the only National Park in China, an extensive area of woodland dedicated to the national hero Dr. Sun Yat-sen. His tomb is preserved in a beautiful mausoleum of traditional Chinese style, with white walls and tiles of heavenly blue which make a striking contrast with the dark green of the forested hillside. Nearby is a most fascinating semi-natural amphitheatre where national celebrations and special concerts are held, and here the annual chrysanthemum show, with its scores of varieties and tier upon tier of colour, is arranged each November. Here also are the Ming Tombs, approached along an avenue flanked by huge stone statues carved in the likeness of lions, dogs, horses, camels, elephants, and finally warriors—all, as always in China, in pairs. After passing through gate after gate into courtyard after courtyard one finds oneself on the open hillside, where the Emperor lies buried with his earthly treasures in an unknown spot safe from marauding thieves.

Here, in and around Nanking, there was unlimited interest for the scientist in a multiplicity of institutions of all kinds—universities, research stations (including especially the National Agricultural Research Bureau, where my particular friend and collaborator, Mr. Yu Chi-pao, was stationed, and where I was always and often made very welcome), many factories, hospitals, various Ministries with their laboratories and technical services, and even two botanic gardens. The daylight hours were never sufficiently long for all that had to be done, and here, as in all of the other cities which we visited, my work was made possible only through the co-operation and support of my wife, who entered into the spirit of my mission and contributed much to its success. With her amazing memory for faces and personalities she gave me invaluable assistance especially, though not only, on the more social side, which is an important element of such an international and inter-racial mission—and differences in language and customs did not make our all-embracing responsibilities any the easier! Towards the end of our visits to each of the larger cultural centres in China we always made a token effort to return some of the generous hospitality shown us by arranging a simple and unpretentious reception to which as many as two or three hundred guests might be invited. It was under such circumstances, when I would remember a man for his cotton breeding, or his work with Chinese drugs, or his new method for the early diagnosis of cancer, or his plans for a new hydraulics laboratory, or his leprosarium, that my wife would introduce the more human aspect by an inquiry after a daughter studying overseas, or a wife and newly arrived twins, or the wedding planned for the coming week. Travelling conditions in the interior might well have deterred many a woman less adaptable to circumstances, though the warmth of welcome everywhere received was more than recompense for all discomforts. Excitements there were many. On one occasion the plane on which we were ready to embark was cancelled because of the arrival of word that the airfield at our destination was under attack. On another occasion we arrived at a railway station to find our train delayed twenty-four hours because a bridge had blown up under the previous night's train. Even normal everyday life provided its thrills. There was, for instance, our journey to Chungking, far up the Yangtze, and on to Chengtu, within sight of the snow-clad foothills of the Tibetan Plateau.

We left Shanghai with the dawn on a cold and blustery May morning—we heard later that it had a typhoon a few hours after—and covered the 800 miles to Chungking by Skymaster in less than five hours. It seemed uncanny to arrive there without any strange happenings on the way. The plane was so comfortable, the sun shone from a cloudless sky and there was not a breath of wind. We had a peaceful journey far above the rapids of the famed and treacherous Yangtze gorges, and gradually approached the rugged mountains of the interior, with their terraced rice fields reaching to the very tops. We made a perfect landing in what seemed a placid hollow deep in the hills, amidst all the warmth and verdure of a subtropical summer. All seemed well with the world. Ten minutes later the excitement began. With the twenty-four passengers from the plane, and probably twice that number of friends and relations who had come to meet them, we and everybody's luggage packed into a bus with seating capacity for twenty. We were the only foreigners, and were last to get on to the bus, but the courteous Chinese had left two seats for us. That two-hour journey to Chungking was something we shall always remember. The road was clear before us—we hoped—and downhill. Along we careered at seventy, with a cloud of jet-black smoke trailing behind us, for many buses in the interior still burn charcoal. At the first hairpin bend, packed as we were, we all fell to one side of the bus, and then as we got around the turn we all fell to the other side. Only we seemed to notice anything unusual. We held on to one another with one hand, the other grasping the seat in front of us. Through the gyrations we caught glimpses of the wonderful hilly countryside, of scattering chickens and pigs, and of the little villages through which we rushed. Our heads crashed against the roof as, with a squealing of brakes, we came to a violent stop. We had arrived in Chungking—city of steps and hills. It was very hot and very sticky. Now that our hands were free, we opened our Chinese fans and started to fan ourselves vigorously, just as our companions had been doing so serenely all the while.

Here in Chungking, as in other towns, the roads and pavements were thronged with people. From out of a sidestreet came a grunting sow and her litter of nine. She appeared tired and distraught and suddenly flung herself down in the dust in the middle of the road. There, amidst all the uncertainties of the passing traffic, she suckled her young. Hundreds of rickshaws were jolting along the road. Bells clanged imperiously on the more elegant private ones, lusty shouts came from the pullers of the more shabby rickety ones that were for hire. Our visits to some of the institutions in this vicinity entailed a ferry trip across the river. The ferry boats were always heavily overladen, and we had been well primed by thoughtful friends with stories of disasters down through the ages. The current was swift, and the ferry boat steered for a point several miles upstream in order to make for the landing immediately opposite. Here, as often, my wife kept her fingers crossed, and complained that they ached most terribly by the time we got across to the other side. But that ache was as nothing compared with what was to come, for bamboo sedan chairs were to be our next mode of conveyance for several miles. When we landed on the far shore we were immediately surrounded by scores of chair bearers eager for our custom. Here were wealthy foreigners good for perhaps ten times the hire that one of their own countrymen could pay, so a good healthy argument developed for our patronage, in the course of which some of the more progressive bearers settled matters by scooping my wife into their chair. She is a light-weight—or looks it—and is therefore a far more desirable passenger than I am. The carrying-handles of six chairs were being jabbed into her ankles in the anticipation that she would necessarily lose her balance, and by the time she did so a pair of sturdy stockings was in shreds—not to mention the bruises and scratches. She was then borne off irresistibly and in triumph, amidst screams of rage from the unsuccessful bearers, who struggled for control of the carrying-handles for the first quarter-mile. I was surrounded by a similar group, and hastily fell into a chair so as to keep fairly near my wife, whilst our Chinese companion-interpreter was left behind, busy bargaining with the leaders in his deep concern to save us a few million dollars! Sedan chairs always sound so romantic. They are made of bamboo, and shaped somewhat like a three-year-old child's pram slung between two bamboo poles. There is one chair bearer at the front and one at the rear. In this chair one is supposed to recline almost at full length, and no doubt after several years' experience one may eventually learn to relax. But to a beginner they provide unanticipated thrills as the bearers scale the sides of precipitous cliffs. Whilst slowly approaching the vertical one wonders how much longer it will be possible to remain in the chair. Never have I felt so utterly helpless as in these chairs—there is nothing that one can do oneself. Once up aloft on the bearers' shoulders it seems quite impossible to get out of the chair by one's own volition, yet equally certain that one cannot possibly remain in much longer. One dare not even turn one's head to see if the remainder of the caravan is still coming along behind—one just grips, until one's nails are embedded deep in the palm of the hand. There are always relays of chair bearers on a long journey—with our party of three there were twelve bearers—and they always appear to choose the narrowest part of the field path, where it is elevated between the muddiest paddy fields, to throw the chair from one set of shoulders to another, or they choose a right-angled bend in the slippery cliff-side path, when the chair itself—and especially the passenger—is overhanging a 500-foot drop into a rocky ravine. The bearers, at some entirely unfathomable signal, suddenly throw the chair off their shoulders and up into the air, and the relieving bearers run in and under the handles as they descend. Wonderful timing—but wonderfully trying to the nerves. The choice of position in which to perform this feat is apparently determined on the theory that the greater the danger, the greater the luck for the rest of the day—if it comes off. This kind of trip, lasting maybe two or three hours, often preceded a lecture; I can think of better ways of conditioning the speaker!

Another complication associated with travelling in the interior is a financial one. Because of the rapid depreciation of local currency it is not possible to arrange beforehand bank drafts or letters of credit sufficient to cover anticipated expenses, as in more ordinary circumstances. Funds must be retained in sterling until as near the actual time of expenditure as possible, and from the practical standpoint can only be converted in one of the coastal cities like Shanghai. During one such ten-week tour in the interior the exchange rate multiplied just ten-fold—from two million to twenty million Chinese dollars to the pound. Prices of commodities of all sorts follow changes in this exchange rate very closely—within a matter of minutes if there are violent fluctuations. Since local currency depreciated so rapidly, one could have in hand only sufficient for a few days' expenses—in any case, one never knew what astronomic amounts would eventually be required. The bank charge for telegraphic transfer of converted funds from Shanghai to the interior was at that time 30 per cent. discount, and the rapid inflation resulted in such a relative shortage of actual currency that conversion of the telegraphed transfer across the counter into actual cash involved a further 20 per cent. discount. And finally one was permitted to draw out only 5 per cent. of one's credit on any one day. A few weeks later, in August, 1948, the National Government made a very brave effort to hold the line, and pegged the pound at 36 million dollars, which, in more manageable figures in terms of a newly introduced unit, was equivalent to twelve "gold yuan." But with military reverses the currency again slipped, and by May, 1949, the pound was equivalent to 360 million gold yuan! It was amazing that the public utilities were able to carry on at all under these circumstances. Their rates could not be changed daily, as were prices of most commodities. They were adjusted at intervals of a few weeks, so that if one took a particular train journey immediately after such an adjustment it might cost the equivalent of five pounds sterling; the same journey the day before the next adjustment might cost only a shilling or two. Similarly the cost of air mail to the United Kingdom would oscillate between the equivalent of about five shillings and less than twopence. This situation had its problems for us—but imagine being paid in such a currency! In areas under Communist domination salaries and banking business are now in terms of stable food commodity units—a certain quantity of millet, or so much pork.

When the time came for us to leave China, my wife and I found that we were leaving behind us many firm friends amongst the Chinese people. Of the basic interest in, and sympathy with, Britain there can be no doubt; amongst the ordinary people there is a genuine willingness to be friendly, and there was no single occasion when we were not shown the utmost courtesy. For the type of work which the British Council is attempting to do, in increasing understanding amongst the ordinary peoples of the world, there is great and urgent need. One of the best ways of encouraging this understanding is through the demonstration of a practical sympathy, but this must be sincere and selfless, on a basis of equality and with no hint of patronage. No more suitable underlying philosophy could be chosen than " Cast thy bread upon the waters . . ." The practical difficulties of putting across such a programme are immense. Not the least of those difficulties lies in organization, and in the co-ordination of the activities of our various government departments. This is work essentially of the spirit, and its results can be measured only in terms of generations. Yet support is given far more generously to time-honoured procedures which lead inevitably and quickly to antagonism, so that small advances in the establishment of confidence achieved only after years of unremitting toil by one agency can be vitiated in a matter of minutes through the thoughtless indiscretion of another department. The major problem, of course, is essentially that of re-orientation of human values. That is a problem which concerns not only Britain; it is the responsibility of all mankind. The particular value which I see in the British Council is not merely in anything which may accrue solely to Britain as a result of its activities. Its great value surely lies in the opportunity with which it presents us as a nation for moral leadership in the furtherance of mutual understanding, tolerance and respect between the nations and races of this world. In order to do this it must be both moulded and used correctly.

Received November, 1949.

NOTES ON CURRENT LITERATURE

COTTON IN INDIA AND IN PAKISTAN

163. India: Expansion of Cotton Cultivation. (*Indian Frmg.*, x, **6**, 1949, p. 258.) The distribution of better seeds, fertilizers, provision of irrigation facilities and introduction of a summer crop in suitable areas are the main features of a Madras Government scheme to increase cotton cultivation as part of an all-India plan sponsored by Sardar Datar Singh of the Central Ministry of Agriculture. A seed-multiplication scheme commenced work in the province in 1948, In the first year an area of 908 acres was taken up and 3,100 bags of seed were distributed. This crop is now reported to be vigorous and healthy. It is estimated that on an average a thousand-pound yield of cotton per acre may be expected this year.

164. Need for Augmenting Supplies of Cotton in the Indian Union. By K. Sawhney. (*Ind. Cott. Grwg. Rev.*, iii, **3**, 1949, p. 115.) In view of the growing discrepancy between mill consumption and cotton production in the Indian Union, consideration of methods of increasing the supply has become imperative. From the long-term aspect it is suggested that the main scope for increasing the area under cotton without affecting the food crop position may be in the areas where it is proposed to reclaim waste and weed-infested lands, or for which irrigation water will be made available from the major irrigation works under construction or contemplation. The Government of India have under consideration concrete plans for the reclamation of 6 million acres of culturable waste and weed-infested lands over a period of eight years. The Central Tractor Organization has already undertaken reclamation operations in the United Provinces, the Central Provinces, and Berar, Madhya Bharat, East Punjab, Matsya Union and Delhi. Though the scheme was designed primarily for increasing food production, a part of such reclaimed land in the cotton tracts will naturally be sown to cotton in accordance with the prevailing rotational practice. When the full eight-year plan under the reclamation scheme is completed, a million to a million and a half acres of new land are likely to be planted to cotton.

Another direction in which the production of cotton may be increased is by the cultivation of suitable perennial types of cotton on cultivable waste lands. Preliminary investigations have been initiated in Dharwar and North Kanara districts of Bombay Province and some districts of Madras. Observations made so far indicate that if perennial cotton of the desired quality can be cultivated on a large scale with success, such cotton would be a good substitute for the much-sought-after L.S.S. cotton from Pakistan. It is an additional advantage that the perennial cotton plant requires wide spacing and therefore permits the growing of food crops in the intervening space between adjacent rows.

165. Spinning Test Reports on Indian Cottons, 1947-48. By D. L. Sen. (*Tech. Circs.*, Nos. 754-762. Ind. Cent. Cott. Comm., 1948.) The circulars contain the grader's report and spinning-test results for African A.R.B.P., 1945-48 seasons; A. R. Busoga, 1941-48 seasons; A. R. Jinga, 1940-48 seasons; Bagalkote Jayawant, 1944-48 seasons; Bawla, 1934-48 seasons; Cambodia Co. 2 (Dharapuram), 1945-48 seasons; Farm Westerns (Bellary), 1940-48 seasons; Jayawant (Hubli), 1942-48 seasons; Upland Gadag, 1939-48 seasons.

166. Spinning Test Reports on Indian Cottons, 1948-49. By D. L. Sen. (*Tech. Circs.*, Nos. 763, 765-769, 771-775, 777, 778, 780-785, 787-790. Ind. Cent. Cott. Comm., 1948.) The circulars contain the grader's report and spinning-test results for African A.R.B.P. 52, 1945-49 seasons; A. R. Busoga, 1942-49 seasons; A. R. Jinja, 1941-49 seasons; Bwala, 1937-49 seasons; Bijapur, 1939-49 seasons; Cambodia Co. 2 (Avanashi), 1945-49 seasons; Cambodia Co. 2 (Dharapuram), 1945-49 seasons; C.P. No. 1, 1941-49 seasons; Farm Westerns (Bellary), 1941-49 seasons; Gaorani 6, 1944-49 seasons; Jarila (East Khandesh), 1943-49 seasons; Jarila (Berar), 1944-49 seasons; Jarila (West Khandesh), 1943-49 seasons; Jayawant (Bailhongal), 1944-49 seasons; Jayawant (Hubli), 1942-49 seasons; Karunganni (Coimbatore), 1942-49 seasons; Malvi, 1943-49 seasons; Navsari, 1942-49 seasons; Suyog (Seg. 8-1), 1945-49 seasons; Verum, 1941-49 seasons; Vijay, 1945-49 seasons; Wagad (Saurashtra), 1945-49 seasons; Westerns (Anantapur), 1944-49 seasons.

167. TECHNOLOGICAL REPORTS ON INDIAN COTTONS, 1948-49. By D. L. Sen. (*Tech. Circs.*, Nos. 764, 770, 776, 779, 786. Ind. Cent. Cott. Comm., 1948-49.) The particulars given include agricultural details, grader's report, fibre particulars spinning test results, remarks.

Cambodia Co. 3.—The 1948-49 sample is similar to its predecessor in respect of mean fibre length, fibre weight per inch and the percentage of mature fibres it contains. It possesses a higher fibre strength; but its fibre length irregularity is somewhat higher. Suitable for 42's warp.

Gaorani 6.—The 1948-49 sample is slightly shorter in staple than its predecessor, but resembles it in practically all other respects. Suitable for 29's warp.

Jarila.—The 1948-49 sample resembles its immediate predecessor in practically all respects, but its intrinsic strength is comewhat lower. Suitable for 28's warp.

Jayawant (*Kumpta*).—The 1948-49 sample is shorter than its immediate predecessor, but possesses practically the same fineness and intrinsic strength even though it contains a lower percentage of mature fibres; it also has a lower fibre length irregularity percentage. Suitable for 35's warp.

V. 434 (*Akola*).—This year's sample resembles its predecessor in all respects. Suitable for 25's warp.

168. GROWTH STUDIES ON SEA ISLAND (*Barbadense*) COTTONS UNDER PUNJAB AND SIND CONDITIONS. By R. H. Dastur. (*Ind. Cott. Grwg. Rev.*, iii, **3**, 1949, p. 121.) A study of the growth of *barbadense* cottons in the Punjab and later in Sind was made with a view to elucidating the causes for the low yields of these cottons in the areas named. The cottons produced luxuriant vegetative growth, but gave low yields on account of a reduction in boll number and boll size. This reduction was greater in the Punjab than in Sind.

The study of the growth of these cottons in the Punjab revealed that the suppression of the fruiting branches occurred at a time when they could be normally formed, on account of long days and prevailing high temperatures. When the temperature dropped the crop came into normal flowering, but by that time the assimilatory activities of the plants were found to be extremely low. Consequently elaborated food materials were not available in adequate amounts for the growth and maturation of bolls. The same was found to be the case, though to a lesser degree, in these cottons grown in Sind.

Nitrogen concentration of the leaves of *barbadense* type grown in the Punjab was also found to be much lower than the nitrogen concentration of the leaves of Egyptian cottons in Egypt at the time of fruiting, though it was equal to that found in the leaves of American cottons at the same stage of development in the Punjab. The climatic conditions were found to be more suitable for the growth of these cottons in South Sind than in the Punjab, but they were not at all similar to those that prevailed in Egypt.

The American cottons in the Punjab and Sind came into flowering at the same time as the *barbadense* types, but the former produced a normal crop of bolls, as the assimilatory activities of the leaves of American cottons were found to be much higher at that stage than those of the leaves of *barbadense* types.

169. INSECT PESTS OF COTTON IN INDIA. By H. D. Nangpal. (*Indian Frmg.*, x, **6**, 1949, p. 279.) The book gives a comprehensive list of the insect fauna associated with the cotton crop and is the first publication of its kind in India; it is, however, rather inadequate for scientific workers. The classification of pests is rather vague and does not give a clear idea about the status of the pests. The Indian names pertain mostly to North India and the references are incomplete

170. CONTROL OF SPOTTED BOLLWORM (*Earias fabia*, S.) IN BARODA. See Abstract 230.

171. COTTON INDUSTRY. (*Cott. and Genl. Econ. Rev.*, 16/12/49.) The Government of India has announced that allocations of foreign exchange will be made immediately available to finance the import of 800,000 bales of cotton from both " soft " and " hard " currency areas to make good the deficiency in domestic supplies. Of this quantity, 220,000 bales have already been secured from the Anglo-Indian bulk purchase of East African cotton. The foreign exchange position will be kept under review, and if possible a further allocation of exchange will be made to finance further foreign imports. Provided the cotton textile export target of 800 million yards can be exceeded, more foreign exchange will be available.

172. COTTON INDUSTRY. (*Cott. and Genl. Econ. Rev.*, 13/1/50.) It is reported that the Import Trade Controller has so far received applications from the mills totalling about 100,000 bales of American cotton. Some of the mills have no combing machinery and they are finding it difficult to use American cotton because of the nep, while there are others who have applied for enough East African cotton and do not wish to be loaded with American cotton and thus add to their already existing financial difficulties. The main snag in the deal of American cotton is that import licences when issued will be valid up to the end of March, 1950, which means that whatever quantity is purchased must be imported by the end of March, 1950. With the present-day lean financial resources of the mills they must think twice before entering into contracts for quantities which would require large sums for payment. In some cases importers have agreed to finance mills' purchases, enabling them to take monthly delivery of cotton extending over several months.

Since applications for only 100,000 bales have so far been received against the Government's decision to provide dollar exchange for the purchase of 200,000 bales, the period of sending applications has been extended up to January 7, 1950.

173. PAKISTAN: CROP FORECAST. (*Wkly. Pakis. News*, 11/2/50.) The revised second forecast of the area under cotton for the year 1949-50 is 2,889,000 acres (American varieties 2,557,000 and Desi varieties 332,000 acres) as against 2,853,000 acres (American varieties 2,376,000 and Desi varieties 477,000 acres) reported in the second forecast of the previous year, showing an increase of 1·3 per cent.

There is a general increase in the acreage of this crop throughout Pakistan, except in Sind, where there has been a decrease of 1·6 per cent. The condition of the crop is normal.

174. TRADE AGREEMENT WITH OCCUPIED JAPAN. (*Wkly. Pakis. News*, 11/2/50.) A trade agreement between Pakistan and Occupied Japan has been ratified by the two countries and remains in force from July 1, 1949, to June 30, 1950. Under it Pakistan will import from Japan cotton piecegoods to the value of Rs.240 lakhs; cotton yarn Rs.300 lakhs; spindles 60,000; looms 500; woollen textile machinery Rs.12 lakhs; knitting machinery and mill-stores Rs.20 lakhs, and other manufactured goods.

Pakistan will export to Japan raw cotton 100,000 bales; raw jute 27,000 bales; raw wool 500,000 lb.; hides 100 metric tons. Other exports from Pakistan include hemp, cotton linters, rock salt, cotton seed and animal by-products.

175. MECHANIZATION OF AGRICULTURE IN PAKISTAN. See Abstract 221.

COTTON IN THE EMPIRE

176. FIJI: SOIL CONSERVATION PROJECT. By C. E. Whitehead. (*Agric. J.*, Dept. Agric., Fiji, **20**, 1, 1949, p. 9.) The most active branch of extension work by departmental officers in recent years has been that dealing with the Soil Conservation projects approved for action in 1946. To date, in all districts many farms have been converted to a contour lay-out and crop rotation; and an increasing number of farmers have been each month converted to contour farming and strip cropping as a means of saving the rapidly waning fertility of their soil. During 1948 a special project at Uciwai—thirty-six miles north-east of Sigatoka—was approved. This undertaking was more ambitious than any hitherto attempted, and on account of its importance from a practical and propaganda point of view approval was given

for the work to be done at Government expense—the landholder and his tenants assisting with their labour. The project was carried out by the local staff of the Department, and the loan of a tractor and grader by the Public Works Department enabled this project to be carried out in a short time. The success of the work is demonstrated by the fact that many farmers in the district have applied for assistance with a similar lay-out for their farms. In the past six months also the permanent nature and value of the work done has been amply put to the test during an unusually long and wet summer.

177. NIGERIA: COTTON INDUSTRY, 1949. (*Half-Yrly Rpt. to December,* 1949.) *Northern Provinces.*—Cotton-seed distribution totalled 7,576 tons compared with 6,468 tons the previous season. This is an increase of 1,108 tons or 17 per cent. All the main cotton-growing provinces show increases and Bauchi and Plateau Provinces are now absorbing 442 tons and 105 tons respectively. The season was characterized by a definite shortage of rainfall in the northern areas; the middle belt had a fairly even and favourable distribution. Some corn failed and had to be replanted, so that cotton in general was planted unduly late in August. September and October rainfall was barely sufficient to keep the crop going, but prospects are better than might have been expected from the generally adverse conditions, though it is doubtful if the total crop will be as great as last year. The Faskari area proved unsatisfactory for stage 4 multiplication of strain 26.C cotton. It was found difficult to exclude cotton from over the Sokoto border, and a change in the area for multiplication at this stage will be required next year. Plans are being considered for reducing the time for the full cycle required to cover all Northern Provinces requirements from nine to seven years by change in seed rates and the use of insecticides and artificial fertilizers to increase yields.

Fourteen new markets were opened and six closed, making a net increase of eight and a total of ninety-three during the current season. Opening dates were fixed at dates corresponding to the previous year's. The firms have co-operated by placing second buyers in all but the smallest markets, a matter which has long been a subject of comment by the Native Administrations. The price remains the same.

Damage from pests including the pink bollworm has not been excessive. The pink bollworm does not appear likely to become a major pest, though measures to combat it and others are being tried out.

Western Provinces.—Meko multiplication area was again planted with improved seed, the first stage with seed from Moor Plantation. Seed distribution in the region during the past four years has dropped from 74,881 lb. in 1946 to 8,726 in 1949, thereby reflecting the falling-off in popularity of cotton as an export cash crop. The export market cannot compete with the demands of the local weaving industry, which now absorbs virtually the whole of the seed cotton produced, and the quantity of seed distributed does not, therefore, represent the acreage planted. The season has, on the whole, been favourable to the crop and disease has not been unusually prevalent.

178. NYASALAND: COTTON CROP. (*Dept. Agric. Rept.,* November, 1949.) In the south the movement of seed to the depots is almost complete and distribution has begun in the Fort Johnston area and in the Ncheu, Dedza, Dowa and Kota Kota areas. The Karonga seed-cotton estimate is now put at 220 short tons. Delayed rain has enabled the harvesting to continue in exceptionally favourable conditions. Final figures for the Northern Province 1948-49 crop, the last of which was shipped to the ginnery in November, show a record crop of 490·6 short tons.

179. CROP PROSPECTS. (*Cott. and Genl. Econ. Rev.,* 30/12/49.) The Karonga cotton crop is developing well, but the acreage is small and the estimate is no higher than 150 tons compared with approximately 450 tons of Trust Land cotton and 30 tons from private estates for last season, the marketing of which has just ended. The last of the Southern Province cotton was also purchased this month following a total of 858 tons, but returns are not yet complete. The deficiency compared with the original estimate demonstrates the serious effect of the drought. Seed issues are well under way both in the Southern and Central Provinces.

180. REPORT ON FLOOD CONTROL AND RECLAMATION ON THE LOWER SHIRE RIVER AND OTHER SPECIFIED AREAS IN NYASALAND. By A. E. Griffin. (London: Crown Agents for the Colonies, 1949. Price 10s.) This report is divided into four sections. The first deals with reclamation on the Lower Shire, including measures for controlling the outflow from Lake Nyasa, and therefore brings in the Upper Shire. The second concerns measures for controlling the outflow of Lake Nyasa in relation to stabilization and flood storage. The third covers other schemes for reclamation and irrigation, and the fourth section deals with the question of investigation and contains recommendations. In the light of data available it would be premature to attempt to suggest definite solutions to any of the problems reviewed in this report, and its object is, therefore, to orientate lines of approach to these problems.

181. REPORT ON REGIONAL ORGANIZATION OF RESEARCH IN THE RHODESIAS AND NYASALAND. By J. E. Keyston. (Salisbury: Central African Council, 1949. Price 5s. From *Nature*, 26/11/49, p. 911.) Dr. Keyston's report is in three parts. The first consists of the survey of the present provision for scientific research in the Rhodesias and Nyasaland, which, on account of the many deficiencies revealed, leads him to conclude that the essential element in effecting collaboration in research is a joint research council. He envisages in particular an arrangement between the three Governments and that of the United Kingdom to enable scientific workers in the Colonial Service, the Colonial Research Service or that of Southern Rhodesia to be seconded for service in any of the three Central African territories without loss of rights and benefits, and the appointment of staff on a joint Rhodesia-Nyasaland basis under the suggested research council.

The second part of the report outlines a suitable constitution for the proposed Rhodesia-Nyasaland Research Council, to which Dr. Keyston appends some notes on such a council as a corporate body; on co-operation between it and the Colonial Office on the choice of a site for its headquarters, which he suggests should be at Salisbury; on the effect of pension provisions on the relative mobility of scientific men in the United Kingdom Government Scientific Civil Service and the Southern Rhodesia Government Service; and on a Central African scientific library and a scientific information bureau for Government agencies in the Rhodesias and Nyasaland.

The major part of the report is a survey of the most important research requirements of the Rhodesias and Nyasaland in which joint action can be recommended. In this Dr. Keyston reviews the different fields of science to illustrate the way in which co-operation in meeting these needs might be furthered by a Rhodesia-Nyasaland research council. In geodetic and topographical surveys, however, he points out that the present need is for separate action by Northern Rhodesia and Nyasaland to augment the efforts of the Colonial Geodetic and Topographical Survey. In regard to agricultural research, the problem of organization is how to recruit and deploy most rapidly sufficient research workers of high quality under able and flexible direction in conformity with a soundly planned strategy. He strongly advocates the establishment of a Central African ecological research unit under the proposed research council, and the council should also seek to foster the increased economy and efficiency which would result from joint use of the services of commodity experts by agricultural departments, as well as arrange co-operation in commodity research with external territories and establish research on a research association basis for the cultivation of any commodity which, like tobacco in Southern Rhodesia, assumes the magnitude of a major industry.

On a rough estimate Dr. Keyston puts the initial capital expenditure on the programme detailed in the third part of the report at £135,850, and the recurrent annual expenditure at £266,000; and a table is appended indicating the distribution of the expenditure between the different activities and the three Governments concerned.

182. SOUTHERN RHODESIA: IRRIGATION PLAN FOR SOUTHERN RHODESIA. (*Times*, 3/2/50.) After representations that the basins of the rivers Sabi and Lundi, in the low veld area comprising almost a third of Southern Rhodesia, were capable of

large-scale development on the lines of the Tennessee Valley, the Government appointed Sir Alexander Gibbs and Partners, of London, to survey the area. The consultants' final report has now been presented, and they find that the area can play an important part in the economy of Southern Rhodesia and is suitable for permanent settlement by both Europeans and Africans. An early pilot irrigation scheme in the Sabi valley, to cost £1 million, is recommended. The long-term project, based on the experience of the pilot scheme, is estimated to cost £20 million, plus the working capital required for actual agricultural operations.

Emphasis is placed on water conservation to enable the development to proceed unchecked during drought years. The dam suggested as the key to the main development would be on the Sabi river near its junction with the Macheke river, and would provide sufficient water to irrigate between 300,000 and 400,000 acres. The report says that while an expansion of the existing road system would suffice for the initial development, a railway would become necessary in time, and a route has been reconnoitred from the existing railway system at Odzi to the Sabi river, down the right bank to Birchenough Bridge, then through coal and iron fields, and finally linking with a possible line joining Fort Victoria to Beit Bridge on the Limpopo. A Sabi valley line, the report adds, could also be readily connected with any future railway linking Beira and Lourenço Marques.

183. Southern Rhodesia: Cotton Twine Production. (*E. Afr. & Rhod.*, 10/11/49, p. 319.) Full-scale cotton twine production is being carried on in Salisbury, Southern Rhodesia, in an effort to alleviate the shortage which occurs every tobacco season. The local product is cheaper than imported twine, and its elasticity is reported to be an added advantage, since it does not cut the leaf so easily as other types of string.

184. Sudan: Cotton in the Anglo-Egyptian Sudan. By R. P. Dunn. (Nat. Cott. Coun. Amer., Tennessee. 1949, p. 55. Price 35c.) The object of this study is to describe the present status and discuss the future possibilities and problems of cotton production and marketing in the Anglo-Egyptian Sudan. It opens with a survey of the area, population and economic background of the country. The succeeding chapter describes the important irrigation schemes which operate in the cotton-growing areas.

The greater portion of the report is devoted to a description of the circumstances under which the Egyptian type cotton is produced; this comprises 92 per cent. of the crop. It is noted that in the Gezira, which is already mechanized to a greater extent than any other cotton-producing area anywhere outside the United States, mechanization may increase rather rapidly in the future. The conditions governing the production of American-type rain-grown cotton, which accounts for the remaining 8 per cent. of the crop, are also noted.

At the present time there is no textile industry operating in the Sudan, and annual imports of textiles amount to 50 to 60 million yards. The Government is planning to construct a small spinning and weaving mill (about 15,000 spindles) to provide cotton textiles for people in the remote south-western region, over 2,000 miles from the seaport. Whilst it is admitted that the efficiency will be low, with native labour, and the cost of production high, it is expected that goods can be manufactured and made available to the local population at less than the price of imported goods, owing to the high inland freight rates.

185. Nuba Mountains Cotton Scheme. (*E. Afr. and Rhod.*, 19/1/50.) It is reported that no effort has been made by the Sudan Government to recover the £E116,444 spent on the Nuba Mountains cotton scheme until last year, but substantial reserves having accumulated, it is now proposed that the Government should be recouped the losses incurred at the beginning of the scheme, plus 10 per cent. for taxation not previously collected. The balance of the reserve will form a cultivator's price equalization fund. The Government will remain responsible for financing the scheme and marketing the crop, to cover which services and research, and as a reward for participation, 10 per cent. will accrue to Government and a further 10 per cent. in lieu of taxation.

186. TANGANYIKA: COTTON CROP. (*Ann. Repr. Dept. Agric.*, 1947. Received 1949.) The report contains a general review of cotton production for 1947 and gives details of the cotton experimental work continued under the charge of three officers of the Empire Cotton Growing Corporation at the stations situated at Ukiriguru and Lubaga in the Lake Province and Ilonga in the Eastern Province. Studies on the maintenance and restoration of soil fertility were continued at Ukiriguru and Lubaga, and included manurial as well as land resting trials. Work at the Ilonga Station continued to be largely in the nature of preliminary development, mapping and choosing building sites. Continuous records of the principal pests were taken throughout the season, and plant development records were also taken in conjunction with these.

187. OVERSEAS FOOD CORPORATION. (*1st Rept. Sci. Dept.*, 1947-48.) Commenting on cotton as an alternating crop in the groundnut scheme, the Report states that two varieties, Ilonga and MU 18, obtained from the Empire Cotton Growing Corporation Stations in Tanganyika, gave 135 and 265 lb. of seed cotton respectively per acre. The growth was vigorous and good, but until the crop can be economically mechanized it is of little interest at Kongwa, where in any case conditions are probably too dry.

188. UGANDA: CROP PROSPECTS. (*Cott. and Genl. Econ. Rev.*, 27/1/50.) Marketing started in the Eastern and Northern Provinces and in Bunyoro on January 3, and in the remainder on January 23. The grade of early receipts in the Eastern Province was disappointing, but there was subsequently a considerable improvement in Busoga, though the quality of Teso and Bukedi was below average. Early receipts at Mengo and Entebbe show satisfactory grade and staple, and are better than last year. Recent rains in Mengo and Entebbe will probably reduce production. The total crop is now estimated at 320,000 bales.

189. COTTON CROP. (*Cott. and Genl. Econ. Rev.*, 18/11/49.) It is reported that an agreement has been reached whereby India and the United Kingdom will take up the entire Uganda crop for the 1949-50 season. India will get 60 per cent. of the crop and the price agreed is 30d. per lb. for BP.52 f.o.b. Mombasa.

190. CHANGE IN THE MARKING OF TWO VARIETIES, 1949-50 CROP. (Lint Marketing Board, Uganda.) In order to give buyers the means of identifying the district from which the cotton originates, so that they may be better enabled to obtain continuity of quality, each lot of BP.52 will in future have marked on the bale a three-letter symbol denoting the area in which it is grown. Particulars of these markings are as follows: Bugerere/South Kyagwe, BP.52/KYG; North Kyagwe/Bulemezi, BP.52/BMZ; Kyadondo/Entebbe, BP.52/NTB; Buruli, BP.52/BRL; Masaka, BP.52/MSK; Mubende-Toro, BP.52/MBN.

The variety BP.50 (S.5302) now in quantity production has been given the nomenclature S.47, by which it will in future be known. The district of origin will also be marked following an oblique stroke after the variety mark; thus West Nile, S.47/WN, and Teso, S.47/T.

191. HISTORY OF THE S.47 COTTON MARK. (Lint Marketing Board, Uganda.) The original selection, B.37, was made in 1929 by Mr. A. L. Stephens from the old mixed Sunflower-Allen crop growing in Bulemezi. This was further selected at Bukalasa by Mr. G. W. Nye, until the grand-daughter strain B.37/5/18 was accepted as Bukalasa Pedigree No. 50 (*i.e.*, BP.50) in 1932. Unfortunately the variety had to be discarded because of its susceptibility to wilt and blackarm diseases. However, using the genetical technique against blackarm developed by Dr. R. L. Knight of the Empire Cotton Growing Corporation in the Sudan, a blackarm resistant nucleus was sorted out in the period 1942-44, and its multiplication began in 1945 under the botanical accession number S.5302. This variety was released from Serere to the first segregated area in 1947, for which reason the brief mark S.47 has been proposed and accepted for this cotton.

The yield of S.47 is about 20 per cent. in advance of the old N.17 type. But the plant is so much neater, and the cotton opens out so much better in the field, that the ordinary grower is likely to pick 30 per cent. more from an acre than he has done in the past. In addition S.47 is better able to withstand the late planting which is inevitable after a late season for food crops. The lint is coarser than that of BP.52, but produces the most mature fibre of any variety yet produced in Uganda. As compared with the lint of N.17, S.47 is slightly finer and appreciably longer. This season about 2,500 tons of S.47 seed should be available, and it is intended that it should be distributed from East Madi to the rest of the West Nile Zone; and from the Teso Segregated Area to North Teso Zone (including Usuku), South Teso Zone, the Bukedea section of the North Central Zone, and, if quantities allow, to the South Lango Zone. The ultimate objective is to grow S.47 throughout the Eastern and Northern Provinces, excepting Busoga for the time being, because wilt disease occurs there. The 1950/51 season should realize upwards of 30,000 bales of the new variety, and the 1951/52 season upwards of 100,000 bales.

192. COTTON GINNERY FOR AFRICAN GROWERS. (*Crown Colonist*, January, 1950, p. 53.) The Uganda Government has completed negotiations for the purchase of a ginnery to be operated on lease by a purely African organization, the Uganda Growers' Co-operative Union. Primary producers in the Protectorate are to receive higher prices for their produce. During December cotton growers will receive an increase of 3 cents for raw cotton (to 33 cents per lb.), while coffee growers will get 4 cents more for Kiboko and 8 cents more for hulled coffee.

193. AUSTRALIA. QUEENSLAND: COTTON INDUSTRY, 1948-49. (*Ann. Rept. Dpt. Agr. and Stock*, 1948-49.) The continued serious decline of the cotton-growing industry in Queensland is regarded as a very significant loss to the nation. It is recognized that the industry could greatly relieve the dollar situation, contribute a quantity of by-products for stock feeding and industrial purposes, and provide a crop with special qualities in a pasture-crop rotation. A case for a guaranteed average net return to growers of 9½d. per lb. seed cotton for a period of five years has been presented to the Tariff Board and the report is eagerly awaited.

At the Biloela Experiment Station irrigation experiments gave promising results. Four out of thirteen strains in one trial yielded between 2,300 and 2,361 lb. of seed cotton per acre. These same strains grown without supplementary irrigation reacted severely to the very adverse conditions experienced at mid-season, 573 lb. of seed cotton per acre being the highest yield obtained.

Several jassid-resistant hybrids and selections are now available for increase as required, and breeding for jassid resistance has been discontinued. Progeny work was continued in the varieties Miller, Triumph and Lone Star, with stress on the replicated testing of the plant breeder's strains. Considerable attention is being devoted to suitability for mechanical harvesting. New varieties being subjected to testing and seed increase include Miller 610, Locket, Empire Deltapine and a group of Acalas.

The results obtained with the McCormick-Deering cotton-picking machine in the trials conducted at the Experiment Station last season were so impressive that arrangements were made this season to test it in sufficient commercial plantings of irrigated cotton in the Theodore irrigation area to allow of representative costs of operation being obtained. The mechanical harvesting trials at the Experimental Station were perforce continued this season with the Rust cotton picker. The trials have not yet been completed, but the results obtained to date confirm previous findings that the Rust picker operates efficiently in clean cultivated cotton with plants of an open habit of growth. Both of these factors are important, for, although the test areas were clean, the machine picked only 77·7 per cent. of the cotton in the Triumph variety and 87·3 per cent. in Miller compared with 97·4 per cent. in New Mexico Acala, which has a much more open habit of growth than the other two varieties. As a whole, the machine picked so efficiently that, wherever possible, it was used to harvest the station's crop of both irrigated and rain-grown cotton.

194. COTTON CROP. (*Cott. and Genl. Econ. Rev.*, 25/11/49.) The Cotton Marketing Board have asked for a guaranteed price of 9·25d. per lb. of seed cotton. The Government have refused this, but have agreed to liquidate the Board's loan from the bank. This will be of considerable assistance, particularly in low-production years. Owing to the low prices obtained by growers over the past few years, cotton production this year is at a record low level, and the total will be little in excess of 500 bales of raw cotton.

The price of American basis grade cotton landed in Australia is now 37d. per lb. and that of Brazilian cotton is approximately 40d. per lb. If Australia could produce only 1,000 bales of raw cotton, it would give a return to growers of 10d. per lb. of seed cotton. The main problem at the present time is to increase production to an economic level. There is an acute shortage of farm labour, and three mechanical harvesters are operating in Queensland this season. A further new improved type machine is expected to arrive for next season's harvesting.

Australian spinners' requirements are approximately 80,000 bales of raw cotton annually, and imports of cotton piece goods are equivalent to approximately 200,000 bales of raw cotton. There is therefore a bright future for the industry in this country, provided labour problems can be overcome.

195. WEST INDIES: COTTON CROP, 1947-48. (*W. Ind. Comm. Cir.*, January, 1950, p. 17.) The area planted in Sea Island cotton for the year 1947-48 was 2,061 acres, of which 333 acres were in St. Kitts, 1,668 in Nevis, and 60 in Anguilla. Total production of lint amounted to 654 bales (322,834 lb.), of which 523 bales (256,009 lb.) were clean and 131 bales (66,825 lb.) were stained. Yields of lint per acre are given as follows: St. Kitts, 180 lb. clean lint, 40 lb. stained; Nevis, 116 lb. clean, 32 lb. stained; Anguilla, 40 lb. clean, 3 lb. stained. The acreage under cotton in St. Kitts in 1947-48 was the lowest for ten years. Acreages in Nevis and Anguilla were higher than in 1946-47, but considerably below pre-war acreages.

COTTON IN THE U.S.A.

196. UNITED STATES: COTTON CROP, 1949-50. (*Cotton*, M/c., 10/12/49.) The United States Department of Agriculture has issued its preliminary final crop forecast for the current season at 16,034,000 bales. It is the eighth largest American cotton crop on record and compares with 14,321,000 bales last year and only 8,640,000 bales in 1946. The yield per acre was put at 285·8 lb., against 313·1 lb. a year ago, the record, and 267·2 lb. two years ago. The revised area was 27,359,000 acres compared with 26,380,000 acres on July 1, 1949.

197. COTTON'S WAY FORWARD. By M. K. Horne. (Bureau of Business Research, Miss. Univ., 1949.) The three outstanding facts of the cotton problem of the United States are (1) the farmers' low income, (2) the new meaning of cotton's competition, and (3) the requirements of the export market. These are discussed at length by the author, and the following suggestions are made for their solution: (*a*) Keep the demand strong through research and merchandising. (*b*) Build a price mechanism to yield as much income as possible without loss of desirable markets. (*c*) Adjust price and production intelligently to changes in the markets. (*d*) Reduce the cost of production. The author points out, however, that a programme based on these objectives is seriously handicapped by the fact that the United States crop is produced by over 1,500,000 independent farming units. Under these circumstances the bargaining position of the cotton farmer is weak, and it is difficult to maintain the standard of efficiency demanded by modern industry in research, management and merchandising.

198. PROGRESS REPORT ON THE ANNUAL VARIETAL AND ENVIRONMENTAL STUDY OF FIBRE AND SPINNING PROPERTIES OF COTTONS, 1948 CROP. (U.S.D.A., Pla. Indus. Sta., Beltsville, Md., August, 1949.) This report summarizes the results of fibre and spinning tests on samples obtained from special plantings made during the crop year 1948. As in previous years, there were included in these studies the leading commercial varieties and new strains of cotton that were of particular interest. This study reports the continuation of co-operative testing that was begun in 1935.

199. FIBRE AND SPINNING TEST RESULTS FOR SOME COTTON VARIETIES GROWN BY SELECTED COTTON IMPROVEMENTS GROUPS, 1949 CROP. (U.S.D.A., Prodtn. and Marktg. Admin., November, 1949.) Test results reported in this supplement are for cottons that have been harvested and processed since those for which similar data were published in August, September and October, 1949. Although some of the cottons tested are from the same market areas that were included in the earlier reports, the cottons on which these results are based were harvested during a later period of the season. Natural changes that occur in fibre and manufacturing properties as the season progresses in a given area are reflected in the test results for cottons harvested during the early, middle and late periods of the season. Many of the cottons for which test results are reported are from the same varieties and market areas that were tested in previous years and afford a basis for comparing spinning results from year to year.

200. Cotton Testing Service. (U.S.D.A., Prodtn. and Marktg. Admin., October, 1949.) The various cotton fibre and manufacturing tests available on a fee basis under the Cotton Service Testing Act are described herein in order to acquaint cotton breeders, producers, merchants, manufacturers and others who may utilize the service with the methods employed in making the tests, and with the significance of the results.

201. United States: Cotton Exports, 1949-50. (*Cotton*, M/c., 28/1/50.) According to the U.S. Department of Agriculture, exports of American cotton this season may exceed the previous season's total of 4,748,000 running bales. The improved outlook, according to the Department, is based on prospective export sales of at least 250,000 bales to India and a probable increase of 100,000 bales to 200,000 bales to Japan.

202. American Cotton Handbook. By A. R. Macormac *et al.* (2nd Ed. New York: Textile Book Publishers Inc., 1949. Price $9.50. From *Text. Tech. Dgst.*, **6.** 11, 1949, p. 821.) This new text covers the material facts of the industry from the historical background of cotton cultivation and machinery development through a comprehensive cotton bibliography. Outlines of all the important functions of the industry and a complete picture of its processes from raw cotton to finished goods are given. A chapter on cellulose and the cotton fibre traces the growth and physical properties of the fibre and develops an empirical formula of cellulose structure. The cultivation and varieties of the cotton plant are discussed in another chapter. The manufacturing processes from ginning and classing through weaving are fully covered.

203. Mississippi Agricultural Experiment Station. (61st Ann. Rept., 1947-48.) A report is given on the cotton improvement research experiment in which tests were carried out in seven locations. The varieties used were Stoneville, Tunica, Jonestown, Money, Valley Hill, Yazoo City and Kelso Plantation. The breeding and improvement programme centred round the production of a high-yielding, rapid-fruiting, early-maturing strain of cotton with extra strong fibres of $\frac{1}{3}/\frac{1}{16}$-inch staple length and possessed of other desirable characters. Particular attention was paid to a number of crosses between Delta Smooth Leaf and several commercial varieties. Seed from glabrous and hairy segregates of five crosses were planted, with parental material, to study the effect of smoothness of leaf on harvesting with a spindle type picker. It was found that in every pair the sample from the smooth-leaf strain graded higher, but it appears that factors other than smoothness of leaf enter into the "pickability" and "cleanability" of the cotton.

204. Texas: Cotton Crop, 1949. (*World Crops*, **2.** 2, 1950, p. 77.) As a result of last year's cotton crop in Texas, and a slow-down in shipping, the Gulf ports of Galveston and Houston are overloaded with cotton and serious congestion has developed. Production for the state was officially put at 5,900,000 bales against 3,153,000 bales in 1948 and a ten-year average of 2,722,000 bales. After some years of declining production Texas once more has become by far the biggest cotton-producing state.

COTTON IN EGYPT

205. Egypt: Cotton Crop Acreage, 1950. (*Cotton*, M/c., 3/12/49.) The Egyptian Government has now decided on its plans for next season's cotton acreage. Under the scheme the growing of Karnak and Menoufi will be confined to the northern part of the Delta, where farmers will be allowed to plant a maximum of 35 per cent. of their total holdings with cotton of these two varieties. There will be no restriction in other districts—the southern part of the Delta, where Giza 30 and Zagora are produced, and Upper Egypt, where Ashmouni is the principal variety grown.

It is estimated that altogether there will be about 700,000 acres under Karnak and Menoufi (producing, say, 3,500,000 kantars of those varieties) with about 350,000 acres under Giza 30, about 75,000 acres under Zagora, and the remainder of the cotton-growing land under Ashmouni; this should produce a total crop of some 10,000,000 kantars under normal conditions. The Government now hold 1,100,000 kantars of cotton, mainly Karnak, while the current crop will provide 2,500,000 kantars of Karnak and 500,000 kantars of Menoufi, making a total supply of well over one year's normal offtake of those varieties.

206. Egypt: Cotton Crop Acreage, 1950. (*Cotton*, M/c., 10/12/49.) The cotton acreage for the 1950 crop has been announced by the Cabinet. The main object is to free production of the medium-staple varieties now most in demand and to limit the long-staple cottons to the best growing areas and to roughly one year's normal consumption. Thus the planting of Karnak, Menoufi and Amoun is restricted to about 700,000 acres in the North Delta, where farmers will be allowed to plant a maximum of 35 per cent. of their total holdings with the above varieties only, instead of last season's 30 per cent. Since in all 939,204 acres were planted last season with long-staple cotton in the whole Delta, this represents a total acreage reduction of 239,204 acres. If the law is strictly observed and yields are normal, it is estimated that this will give about 3,500,000 kantars, and, as the districts chosen are the most suitable for the long-staple cottons. the quality of the crop should be good.

Elsewhere in Egypt cultivation will be free. Landowners will be permitted to plant as much of their land as they choose, in the South Delta with Giza 30 and Zagora, and in Upper Egypt with Ashmouni. Those in the South Delta who might suffer by being forbidden to cultivate the higher-priced long-staple varieties may recuperate by planting a greater acreage with medium-staple; moreover, the long-staple crop will not be adulterated by the lower quality cotton usually produced in these areas. It is understood that the growers in the South Delta nowadays dislike planting Zagora if anything else is available, owing to its comparatively poor yield. Therefore, in order to prevent a rush in this area for Giza 30 seed and a resultant black market in it, the Government is to requisition all seed of the later variety and control its fair distribution to the farmers. It is estimated that under these conditions approximately three-quarters of the South Delta will be under Giza 30 and the rest Zagora. A crop of from 10 to 10½ million kantars can be expected, showing an increased production of about 2 million kantars medium and short staples—*i.e.*, Giza 30, Ashmouni and Zagora—over that grown this year. It is estimated that under present conditions this can easily be absorbed provided prices do not become exorbitant.

COTTON IN OTHER FOREIGN COUNTRIES

207. French Equatorial Africa: Cotton Production. (Int. Cott. Adv. Cttee., December, 1949.) In the 1948-49 season, seed-cotton production was equivalent to 110,000 bales (478 lb.) of cotton, slightly greater than the previous record crop in 1945-46. Reports suggest a continued expansion, especially in the Tchad region. With improved methods of cultivation and the planting of more suitable varieties, an eventual output of about 140,000 bales of cotton is expected.

208. Sansanding: Les Irrigations du Niger. By G. Spitz. (Société d'Éditions Géographiques, Maritimes et Coloniales, Paris, 1949. Price in Britain 9s. From *World Crops*, 2. 2, 1950, p. 49.) This book gives a comprehensive account of the French project for the growth of irrigated rice and cotton on the Middle Niger. In 1929 the scheme envisaged an irrigable area of 960,000 hectares which would absorb 300,000 settlers besides the original inhabitants. By 1948, however, it had achieved the irrigation of only 17,950 hectares serving a population of 25,400.

The scheme is comparable to that of the Gezira, and the French area of operations lies in almost exactly the same latitude as Wad Medani in the Sudan. Egyptian cotton, however, has not been a success in the areas so far irrigated, and with a cotton crop based largely on the Upland variety Allen there are many analogies also with Uganda. There is thus much in an account of the scheme to interest British readers.

The administration of the scheme has been successively in the hands of the Compagnie Générale des Colonies, the Service Temporaire des Irrigations du Niger from 1925, the Service du Niger from 1930, and finally the Office du Niger since 1932. The great dam, 2,616 metres long, across the Niger at Sansanding which now supplies most of the irrigation water came into full working order in 1948. Only partial mechanization is practised in the cultivations. Mechanical equipment is said to be particularly useful for turning under green manure (which is grown alternately with cotton in a two-year rotation), and for deep ploughing of rice lands once in every three or four years, which is necessary to control the growth of wild rice. Average yields per acre on the scheme are about 700 to 900 lb. of seed cotton and 1,600 to 1,800 lb. of paddy rice.

209. GREECE: COTTON INDUSTRY. (*Cott. and Genl. Econ. Rev.*, 16/12/49.) In 1949 cotton production amounted to 15,500 metric tons, an increase of 3,800 metric tons over the previous crop. Mill consumption in 1948 amounted to 17,951 metric tons. There are fifty-two cotton mills in Greece with 311,185 spindles in operation. The bulk of the yarn produced is below 32's. Each spinning mill has its own weaving shed, and the total number of looms is 7,660. In addition more than 16,000 wooden looms are installed in different town and villages, where a flourishing handcraft industry is carried on. Imports of foreign cotton into Greece during 1948 totalled 3,956 metric tons.

210. MEXICO: COTTON CROP. (*World Crops*, 2. 1, 1950, p. 46.) The 1949-50 crop in Mexico, now estimated at 815,000 bales, is by far the largest on record and approximately double the 1940-44 average. Acreage was increased from 1,050,000 acres in 1948 to 1,334,000 in 1949. One of the principal factors responsible for the sharp upward trend in acreage since 1946 is the opening of new irrigation systems in or near the principal areas already producing cotton. Devaluation of the peso on July 22, 1948, from the equivalent of 20·6 cents to 14.4 cents enhanced cotton prices in terms of Mexican currency and provided a strong incentive to increase production in 1949. A further stimulus to production was the liquidation in 1947-48 of all surplus stocks accumulated during the war period and the initiation of improvements in the ginning and handling of cotton that made the Mexican staple more readily acceptable in foreign markets.

211. PARAGUAY: COTTON INDUSTRY EXPANSION. (*Ambassador*, 1. 1950, p. 120.) The 1949 cotton crop in Paraguay is expected to be about 10,710 metric tons, or 50,000 equivalent bales of 478 lb. each. This shows a considerable increase on the crop of the previous year, but widespread damage by insects has made it smaller than was originally estimated

During the 1948-49 season domestic mills consumed about 4,500 bales of 450 lb. each. Many expansions in these mills should mean that consumption increases during the current season: it is anticipated that the expansion programme being carried out in one mill will be complete very early in 1950, when this mill will produce a variety of cotton cloths. Another mill is also expanding its capacity, and a third concern has recently announced its plans for the manufacture of inexpensive cotton cloth, in the course of which about 300 tons of cotton fibre will be required every year. In the twelve months ending with July, 1949, exports totalled 28,000 bales, all of these being shipped to Argentina and Uruguay. The policy of the Paraguayan Government is to sell cotton only in exchange for dollars, but shortages of dollars have recently obliged them to modify this and 1,000 metric tons of cotton were sold by Paraguay to Sweden in August, 1949.

212. PERU: COTTON INDUSTRY. (*Ambassador*, 1. 1950, p. 120.) An increased domestic demand for cotton by Peruvian mills has been noted. Enlargements to the mills, better prices, improved labour conditions, and the rising popularity of cotton and rayon are obvious reasons for this increased demand; during 1948, 13,683 metric tons were consumed, as against 12,006 tons in 1947, and not more than 11,500 in any of the five preceding years. Reports from the mills for the first six months of 1949 indicate that there is likely to be an increase of at least 10 per cent. in the amount consumed during the year, compared with the 1948 figure.

The actual 1949 cotton crop in Peru is estimated at about 57,000 metric tons, or 265,000 equivalent bales of 478 lb. During the period January-August, 1949, exports totalled 645,000 quintals of about 100 lb. each, compared with 730,989 quintals during the same period in 1948. Exports of cotton to the United Kingdom increased considerably during 1949, and shipments were also registered to India and Argentina.

SOIL, SOIL EROSION AND FERTILIZERS

213. Rothamsted Experimental Station. The Report for 1948 is prefaced by a brief summary of the Station's history from the time of its foundation in 1843. The work carried out during 1948 is reviewed by the Director. Fuller details are given by heads of departments in their reports on the laboratory investigations and field work carried out under their direction. The Report includes a summary of over a hundred papers which have been published in various scientific journals in the course of the year.

214. Gully Control. By K. J. McKenzie. (*Rhod. Agric. J.*, xlvi, 5. 1949, p. 355.) The author sets out the causes and consequences of gully formation, and gives a list of basic control measures. Useful notes on types of bolsters and checks are given together with helpful information concerning their construction.

215. Soil Conservation Project in Fiji. See Abstract 176.

STATISTICAL TREATMENT, CULTIVATION, GINNING, ETC.

216. Flame Cultivation in Cotton, Yazoo-Mississippi Delta, 1947. By C. B. Danielson and G. B. Crowe. (*Miss. Agric. Exp. Sta., Cir.* 143, 1948.) Weed and grass control is one of the main bottlenecks in the complete mechanization of cotton growing. In 1947 cotton was produced and harvested on the Delta Branch Experiment Station with 39 hours of man labour per acre. Chopping and hoeing for weed and grass control accounted for 32 of the 39 hours total. This progress report is a by-product of a larger study relating to cotton mechanization. It is based on records for one year only, therefore it is not conclusive. However, because of the importance of the weed-control problem it is considered desirable to report the results and point out limitations.

In 1947 flame cultivators were practically all tractor-mounted and used liquefied petroleum gases—propane or butane—as fuel. Vaporizers are optional equipment on some makes of machines. Most machines depend either upon the action of self-energizing burners or upon vaporization within the tank to provide a steady fuel supply. Quick cut-off valves make it easy to control the flame when turning or when making mid-field stops. The machines give best results when grasses and weeds are small. Heavy infestations of older growth seriously lower the efficiency of flame cultivation.

COTTONSEED AND COTTONSEED PRODUCTS

217. The Marketing of Cotton Seed. By M. E. Whitten and J. H. Stevenson. (U.S.D.A., Prodtn. and Marktg. Admin., November, 1949.) The principal objectives of this study are: (1) to provide basic information and data relative to the cottonseed marketing structure, and (2) to evaluate the practices, costs and facilities of marketing cotton seed with a view to suggesting possible improvements in marketing methods and to reducing costs.

Production of cotton seed during the 1947-48 season totalled about 4·7 million tons, a volume very similar to the average seasonal production of approximately 4·6 million tons during the ten seasons 1938-39 to 1947-48. With practically identical production, however, the farm value of the cotton seed produced in 1947-48 totalled about $402 million, and was approximately twice as great as the annual average for the ten-year period ending in 1947-48.

218. COTTON SEEDS, PIGMENT CONTENT. See Abstract 244.

219. COTTON-SEED PROTEIN FIBRE. By J. C. Arthur and J. G. Many. (*Text. Res. J.*, 19, 1949, p. 605. From *Text. Tech. Digst.*, 7. 1, 1950, p. 3.) The preparation of fibres from cottonseed protein is described. The fibres have a dry strength of 0·6 to 0·7 g. per denier, a wet strength of 0·2 to 0·3 g. per denier, are yellow-orange in colour and soft to handle.

220. COTTON-SEED HULLS, USE IN NYLON MANUFACTURE. (*Ind. Cott. Grwg. Rev.*, iii, 3. 1949, p. 161.) A new method of processing cotton-seed hulls which will yield a chemical used in nylon manufacture and petroleum refining has been perfected. The South Carolina Cotton-seed Crushers Association recently announced the process evolved by Dr. H. Shiver, head of the Chemistry Department of the Converse College in Spartanburg. Rights to the method have been granted to the Quaker Oats Company and machinery is being adapted for the extraction process. The problem facing Dr. Shivers was the removal of the hull's outer and inner layers without destroying the hull core containing the necessary chemical, pentosan. His mechanical process rubs hulls together and breaks them up so that the layers separate from the hull core. The pentosan is used to form a product known as furfural, used in nylon and plastic manufacture.

MACHINERY

221. MECHANIZATION OF AGRICULTURE IN PAKISTAN. (*Brit. Farm. Mechztn.*, 2. 12, 1950, p. 72.) A scheme for the establishment of a Central Institute of Agricultural Engineering Research and Traction Technology has been announced in Pakistan. The main function of this Institute will be to conduct research on the utilization, adaptation and adjustment of imported machinery at work in the varied soils and climates of Pakistan. It will also function as a training centre for technicians and as a machinery repair depot. Fleets of tractors will be maintained for the land reclamation projects which are at present under consideration. Until the primary need for a machinery testing station and training facilities for farm operatives is established, Pakistan will not be in a position to contemplate any expansion of mechanization.

222. REPORT OF THE PROCEEDINGS OF THE THIRD ANNUAL BELTWIDE COTTON MECHANIZATION CONFERENCE, AUGUST, 1949; BENNETTSVILLE, SOUTH CAROLINA. (Nat. Cott. Council of America, pp. 172.) The 1949 conference had a twofold purpose; first, to stimulate interest in continued and progressive research and education in cotton mechanization, and second, to promote the development and use of machines adapted to the various jobs on cotton farms over the cotton belt. In the previous two years conferences were held in the Mississippi Delta and in the High Plains area of Texas, where cotton farms are extensive and well adapted for mechanization. In contrast, the 1949 conference was held in an area where many of the fields are smaller, more irregular-shaped and limited to the use of lighter mechanical equipment than are the other areas of the cotton belt. The theme of the conference was " Tooling for the South's New Pattern of Agriculture," and the report contains addresses on widely varied aspects of cotton mechanization. Tables showing comparative yields and costs are included, and agricultural engineering, soil conservation and the soil fertility requirements of cotton are also discussed.

223. NEW BRITISH POWER DUSTER. (*World Crops*, 2. 1, 1950, p. 44.) It is generally agreed that crop protection by insecticides and fungicides is more efficiently secured by spraying than dusting. Many important cases occur, however, where spraying is difficult or impracticable and where dusting would be much easier. Spraying requires either a piped water supply on the farm or plantation, or it must be conducted with heavy water-carrying machinery as well as with the actual spraying equipment. Also, under certain climatic conditions, the water supply may be insufficient at a time when pests are attacking crops severely. A new power duster has recently been produced in England. It has been designed by Dr. Kearns and N. G. Morgan of Long Ashton and the prototype and subsequent machines have been built by Messrs. Welding Industries Ltd., of Bristol. The power duster has already been used in Zanzibar to protect the clove crop from the " sudden death " disease and in Nigeria for locust control. It is claimed that applications from 1½ lb. per acre upwards can be distributed. The duster is self-motored and mounted on a two-wheeled trailer chassis. Upward, side and rearward directions of power dusting can be obtained and the angles of these deliveries are widely adjustable. The machine is robust in construction and offers a wide range of dust application performance.

PESTS, DISEASES, AND INJURIES, AND THEIR CONTROL

224. CONTROL OF THE COTTON FLEAHOPPER BY CHLORINATED CAMPHENE, DDT AND SULPHUR. By C. R. Parencia and K. P. Ewing. (*J. Econ. Ent.*, **41.** 5, 1948, p. 735. From *Rev. App. Ent.*, **38.** Ser. A, 1, 1950, p. 18.) *Psallus seriatus*, Reut., has been successfully controlled on cotton in Texas since 1946 with a dust containing 5 per cent. sulphur applied early in the season, but this does not control *Anthonomus grandis*, Boh., which is often present in potentially injurious numbers, and frequently results in increased infestation by *Aphis gossypii*, Glov. Since preliminary experiments indicated that chlorinated camphene (toxaphene) was promising against all these insects, it was compared with the dust of DDT and sulphur against *P. seriatus* in 1947. On small plots treated four times in June, the DDT dust and dusts containing 1·25-10 per cent. toxaphene all gave significant control, though 1·25 and 2·5 per cent. toxaphene were significantly less effective than 10 per cent., and all but 1·25 and 10 per cent. toxaphene gave significant increases in yield; 5 per cent. toxaphene was as effective as the DDT twenty-four hours after treatment, but had a much less persistent effect, and 10 per cent. toxaphene was required to equal the DDT in persistence.

In large-scale tests at Port Lavaca, in which one to three applications were made in June or late May and June and all materials gave good control and increases in yield except when root rot intervened, 10 per cent. toxaphene, alone in clay and pyrophyllite or with 50 per cent. sulphur, was as effective and persistent as the DDT dust, and resulted in larger yields, possibly owing to the control of small infestations of other insects; 5 per cent, toxaphene was as good as DDT in immediate kill, but had less persistent effect. On some plots toxaphene without sulphur resulted in increases in red spiders. In a large-scale test where three applications were made in June and July, 10 or 20 per. cent. toxaphene gave good control and sulphur alone very little. Cotton dusted with toxaphene began to fruit much more quickly and was ready for harvesting several weeks earlier than cotton dusted with sulphur and yielded 67 per cent. more than untreated cotton, as compared with 30 per cent. increase from sulphur. Toxaphene was found to act so quickly on the fleahoppers that rain soon after dusting made little difference to the results.

225. BOLLWORM CONTROL WITH CHLORINATED CAMPHENE, DDT, AND MIXTURES OF BENZENE HEXACHLORIDE AND DDT. By C. R. Parencia and K. P. Ewing. (*J. Econ. Ent.*, **41.** 3, 1948, p. 406. From *Rev. App. Entom.*, **37.** A, 11, 1949, p. 423.) Two small-plot and six large-scale field experiments were carried out at Waco, Texas, in 1947 to compare the effectiveness of different dusts against *Heliothis armigera*, Hb., on cotton.

In one small-plot test 20 per cent. chlorinated camphene (toxaphene), a mixture containing 3 per cent. γ BHC (benzene hexachloride), 5 per cent. DDT and 20 per cent. sulphur, 10 per cent. DDT in sulphur or pyrophyllite, and calcium arsenate, all significantly reduced injury to bolls by *Heliothis*; calcium arsenate was the least effective and significantly less effective than any of the other dusts except toxaphene. Infestation by *Aphis gossypii*, Glov., increased significantly on the plots dusted with calcium arsenate and 10 per cent. DDT in pyrophyllite. There were no significant differences in yield. In the second small-plot tests, dusts of 10 or 20 per cent. toxaphene with 50 per cent. sulphur, 10 per cent. toxaphene with 5 per cent. DDT and 50 per cent. sulphur, 3 per cent. γ BHC with 5 per cent. DDT and 20 per cent. sulphur, and 5 per cent. DDT with 75 per cent. sulphur reduced the injury to squares significantly with no significant difference between treatments. They all reduced boll injury significantly, 10 per cent. toxaphene with 5 per cent. DDT being significantly more effective than all other treatments except 20 per cent. toxaphene. The yield was significantly increased by 20 per cent. toxaphene and by DDT with toxaphene or BHC, with no significant differences between them.

In large-scale experiments in which 3-5 applications were made in late July and August, 20 per cent. toxaphene, 5 per cent. DDT with 3 per cent. γ BHC and 10 per cent. DDT gave about equal control of *H. armigera* and were better than calcium arsenate. In some instances, a severe infestation of red spider mite (Tetranychus) followed the use of toxaphene in an inert diluent, but this was prevented by including at least 50 per cent. sulphur in the dust.

226. CONTROL OF BOLL WEEVIL AND COTTON APHID WITH BENZENE HEXACHLORIDE AND CHLORINATED CAMPHENE IN 1947. By M. T. Young. (*J. Econ. Ent.*, **41**. 3, 1948, p. 401. From *Rev. App. Entom.*, 37. A, 11, 1949, p. 422.) Further field-plot tests of dusts containing organic insecticides in programmes for the control of *Anthonomus grandis*, Boh., and *Aphis gossypii*, Glov., on cotton were made in Louisiana in 1947, and their effect on infestation by *Tetranychus bimaculatus*, Harvey, was also observed. Treatments were begun when about 25 per cent. of the squares were infested by the weevil, and applications were made six times at intervals of four to five days and, in the case of BHC (benzene hexachloride) and chlorinated camphene (toxaphene), four times at intervals of seven to nine days.

The percentage of squares infested by the weevil and the numbers of the Aphid and the mite per square inch of leaf averaged 49, 1·36 and 3·1 for no treatment; 30, 5·18 and 1·9 for calcium arsenate; 30, 0·54 and 1·5 for calcium arsenate with the addition in alternate applications of 2 per cent. nicotine; 27, 1·29 and 2 for calcium arsenate with the substitution of 5 per cent. γ BHC in one of the first four applications; 30, 2·68 and 2·1 for calcium arsenate with the substitution of 20 per cent. toxaphene in the first, second or fourth applications; 41-29, 0·55-0·07 and 3·8-6 and 36-24, 0·15-0·16 and 7-7·6 for four and six applications respectively of 1·25-5 per cent. γ BHC; and 47-39, 0·88-0·43 and 4-8·3 and 47-32, 0·62-0·21 and 3-3·7 for four and six respectively of 5-20 per cent. toxaphene. Whether treatments were applied in the early morning or late afternoon made no difference to BHC, toxaphene or calcium arsenate alone or with nicotine; the other treatments were made in the early morning. The yield was significantly increased by all the calcium-arsenate treatments and by the highest concentrations of BHC and toxaphene when applied six times, the differences between these not being significant.

227. CAGE TESTS AGAINST THE BOLL WEEVIL AND THE TARNISHED PLANT BUG WITH SYNTHETIC ORGANIC INSECTICIDES AND CALCIUM ARSENATE IN 1947. By A. L. Smith and G. L. Smith. (*J. Econ. Ent.*, **41**. 3, 1948, p. 403. From *Rev. App. Entom.*, 37. A, 11, 1949, p. 422.) The results are given of three series of cage tests carried out in Louisiana in 1947 with chlordan, BHC (benzene hexachloride), chlorinated camphene (toxaphene), parathion, DDT and methoxy-DDT in dusts applied at 8 lb. per acre against *Anthonomous grandis*, Boh., and *Lygus oblineatus*, Say., on cotton. In the first, dusts containing 0·5, 1 or 2 per cent. parathion, 5, 10 or 20 per cent. chlordan or toxaphene or 1·25, 2·5 or 5 per cent. γ BHC were applied against *Lygus* between June 30 and July 18 and compared with calcium arsenate against the weevil between July 14 and August 25. At comparable concentrations (high, low or intermediate) BHC was the most effective against *Lygus*, parathion and toxaphene about equal, and chlordan the least toxic; the highest concentration of each was significantly better than either of the lower ones. The highest concentrations of chlordan, toxaphene and BHC were as effective as calcium arsenate against the weevil, but lower concentrations were significantly less effective, and parathion was much less effective than any other material tested.

The second series was made against *Lygus* during late July and early August and against the weevil between August 5 and 27. When the organic compounds were used alone against *Lygus*, 3 per cent. γ BHC and 2·5 per cent. parathion gave high and about equal mortality, 5 per cent. DDT and 10 per cent. toxaphene were rather less effective but equal to each other, and 10 per cent. chlordan was much less so, though significantly better than calcium arsenate. Mixtures of any two of the organic compounds at the concentrations stated were about as effective as the best of the single treatments. Against the weevil, all the organic insecticides except DDT, and all the mixtures of them, were about as effective as calcium arsenate.

The third series was carried out against *Lygus* between July 7 and 23 and against *Anthonomus* between July 15 and August 11. Against *Lygus*, mixtures of 3 per cent. γ BHC or 10 per cent. chlordan with 5 per cent. DDT were as effective as 6 per cent. γ BHC alone; 20 per cent. chlordan alone and 5 per cent. chlordan with 5 per cent. DDT were less effective, 50 per cent. methoxy-DDT still less so, and 5 and 10 per cent. chlordan alone ineffective, possibly owing to their poor dusting qualities. Against the weevil, 20 per cent. chlordan, 10 per cent. chlordan with 5 per cent. DDT, 50 per cent. methoxy-DDT and calcium arsenate were the most effective, with no significant differences between them.

228. EFFECTIVENESS OF INSECTICIDES ON THE BOLL WEEVIL IN COTTON SQUARES IN 1947. By R. C. Gaines and A. L. Scales. (*J. Econ. Ent.*, **41.** 3, 1948, p. 519. From *Rev. App. Entom.*, **37.** 1, 11, 1949, p. 438.) In 1947 tests were made in Louisiana to determine the effect of various insecticides used as dusts for the control of *Anthonomus grandis*, Boh., on the stages of the weevil within the cotton squares. Examination of squares collected on the ground on August 11, after three to four applications of dusts in late July and early August, showed that the percentages of squares with living insects (adults, pupæ or larvæ), dead insects, emergence holes only and egg punctures only were 41, 3, 17, 39 on untreated plots, 27, 22, 23 and 28 on those treated with calcium arsenate, with the addition of 2 per cent nicotine in alternate applications,. 41, 29, 7 and 23 for a mixture of 3 per cent. γ BHC (benzene hexachloride), 5 per cent, DDT and 40 per cent. sulphur, 41, 29, 3 and 27 for 20 per cent. chlordan, and 53, 15, 8 and 24 for 3 per cent. chlordan with 3 per cent. DDT.

Squares with egg punctures were collected from untreated plants on August 18 and from the ground under untreated plants on August 20. Those collected from plants usually contain eggs and young larvæ and those from the ground larvæ, pupæ and adults. Squares collected on 18th were exposed for twenty-one days in airtight globes to the vapours of 20 per cent. chlordan, 5 per cent. γ BHC, 20 per cent. chlorinated camphene (toxaphene) or 5 per cent. parathion, and those on 20th were dusted fairly heavily with the same materials and kept in the globes for nineteen days. The percentages from which adults emerged in the first and (in brackets) second series were 85 (51) for the controls, 0 (0) for chlordan, 4 (0) for BHC, 72 (29) for toxaphene and 10 (8) for parathion. Examination of the squares showed that weevils exposed to chlordan vapour in the first test reached the adult stage and died within the squares. Both larvæ and adults died in the second test. BHC killed more in the larval than in the adult stage. When four heavy applications of the same dusts were made to cotton plants on August 18, 22 and 28 and September 2 and cotton squares were collected from the ground three to five days after each, the percentages of squares from which adults emerged averaged 57 for no treatment, 70 for parathion, 63 for toxaphene, 41 for BHC and 14 for chlordan.

(*Cf.* Abstract 103, Vol. XXVII of this Review.)

229. EXPERIMENT IN METHYL BROMIDE FUMIGATION OF BULK COTTON SEED FOR PINK BOLLWORM CONTROL. By G. L. Phillips and W. G. Bodenstein. (*J. Econ. Ent.*, **41.** 5, 1948, p. 804. From *Rev. App. Ent.*, **38.** Ser. A, 1, 1950, p. 24.) As it had been shown that larvæ of the pink bollworm (*Platyedra gossypiella*, Saund.) in cotton seed can be killed by fumigating with moderate dosages of methyl bromide, the possibility of distributing the gas effectively enough to destroy them in a large mass of seed was investigated in three experiments in Oklahoma. The seed was fumigated in a cylindrical tank 48 ft. high and having a capacity of 56,345 cu. ft., supplied with an air-circulating system that withdrew air from beneath a false floor and returned it at the top and established circulation through a load of 550 tons of seed within five to eight minutes.

The distribution of the methyl bromide was studied by putting samples of infested cotton seed at various points throughout the load and by sampling the gas at intervals at several points. In the first test, fifteen cages of adults of the flour beetle *Tribolium*) and larvæ of the carpet beetle (*Anthrenus scrophulariæ*, L.) were also distributed at intervals. It took about three days to fill the tank with 450-550 tons of seed. When the load had reached the desired level, all openings were sealed and air circulation was established by running the fan for ten minutes before the introduction of the gas. The gas was released from 175-lb. cylinders directly into the circulating system, which took six to seven and a half minutes per cylinder, and first appeared at the bottom of the load in four to six and a half minutes. The fan was operated for ten minutes after all the gas had been released to mix it with the air in the tank. At the end of the exposure period, the exhaust vent was opened and the fan operated for eight to twelve hours until no trace of gas was evident in the exhaust stream. Insect samples were removed as the seed was unloaded over a period of two to three days.

The methyl bromide was used at rates of 3, 4½ and 6 lb. per 1,000 cu. ft. for twenty-four hours. Analysis of gas samples showed that at least 55 per cent. of the applied dosage was present at all points tested within one hour and that the concentrations were 31·5-87·5, 50-69·5 and 55-75 per cent. of the applied dosages after two hours and 17·5-58, 15·5-40 and 14·5-45 per cent. after twenty-four hours in the three tests, respectively. All the treatments gave complete mortality of the insects in all the biological examples.

230. CONTROL OF SPOTTED BOLLWORM (*Earias fabia*, S.) IN BARODA. By R. M. Patel. (*Ind. Cott. Grwg. Rev.*, iii, s, 1949, p. 135.) The spotted bollworm is mainly responsible for bringing about considerable loss to the cotton crop in the Baroda district. The Plant Puller Propaganda scheme for uprooting of cotton stalks as organized by the Indian Central Cotton Committee in the Baroda district from 1936-41 failed to yield worth-while results, owing to the carelessness of cultivators who failed to uproot the stubbles in time to create a clear gap in the availability of food for a period of at least one month.

The Baroda State Agricultural Pests and Diseases Act, enacted in 1940, made it compulsory for every farmer to uproot the cotton stalks before May 15, and the area cleared in the prescribed manner by May 15 was as follows: 98·5 per cent. in 1943-44, 99·4 per cent. in 1944-45, and 99·7 per cent. in 1945-46 and 1946-47.

According to investigations carried out in 1935, the estimated damage by spotted bollworm was 40-50 per cent. in shoots, 34-51 per cent. in buds, and 20-69 per cent. in bolls, resulting in an accumulative reduction in the yield of kapas by at least 20 per cent. With the operations under the Pest Control Act, the spotted bollworm infestation in 1946-47 in shoots, buds and bolls did not exceed 0·5, 0·7 and 1·9 per cent. respectively, which resulted in increasing the yields of the cotton crop by 19 per cent.

231. PREMATURE DROPPING OF THE LEAVES AND BOLLS OF COTTON. By C. H. Reiniger. (*Bol. Fitossanit.*, **2.** 2, 1947, p. 129. From *Rev. App. Ent.*, **38.** Ser. A, 1, 1950, p. 40.) Severe dropping of the leaves and bolls of cotton at Ipu, in the State of Ceará, was found to be due to *Hercothrips fasciatus*, Perg., which had not previously been recorded from Brazil. Its eggs are deposited in the petioles and leaves, and the nymphs and adults feed on both surfaces of the latter. Good control was given by sprays of 0·15 per cent. nicotine sulphate and 0·15 per cent. soap or of 3·5 lb. timbo powder (6 per cent. rotenone) and 2 lb. soap per 100 gal. water.

232. CONTROL OF THRIPS ON COTTON. By J. C. Gaines *et al.* (*J. Econ. Ent.*, **41.** 3, 1948, p. 510. From *Rev. App. Entom.*, **37.** A, 11, 1949, p. 436.) The results are given of further investigations on the control of thrips, chiefly *Frankliniella tritici*, Fitch, on cotton carried out in Texas in 1947. In one test, in which sprays and dusts were applied on April 18, before the thrips migrated into the field from weeds, April 29 and May 13 at average rates of 11 U.S. gal. and 12·5 lb. per acre respectively, and all plants received applications of a mixture of BHC (benzene hexachloride), DDT and sulphur later in the season against weevils (*Anthonomus grandis*, Boh.) and bollworms (*Heliothis armigera*, Hb.), a 1 per cent. DDT spray and dusts of 20 per cent. chlorinated camphene (toxaphene), 3 per cent. γ BHC and 3 per cent. γ BHC with 5 per cent. DDT, all in sulphur, were effective against the thrips, and a spray of 2 oz. tartar emetic and 1 lb. syrup per 3 U.S. gal. water and dusts of 5 per cent. DDD or DDT in sulphur were ineffective. All treatments significantly reduced the percentages of "thrips injured" plants, but did not increase the yield. In a second test, in which dusts were applied on April 21 and May 2 and 14 at an average rate of 11·5 lb. per acre and all plants received calcium arsenate later in the season for the control of *Anthonomus*, 20 per cent. toxaphene gave good control, and 3 per cent. γ BHC with 5 per cent. DDT or alone in sulphur was less effective and 5 per cent. DDT in sulphur useless. None of the treatments increased the yield. The thrips population was higher in the second test than in the first, but the percentage of "thrips injured" plants was lower, indicating that other factors are probably responsible for this injury. The dust of 5 per cent. DDT in sulphur was less effective than in previous years, possibly owing to different weather conditions.

(*Cf.* Abstract 234, Vol. XXVII of this Review.)

233. A NEW SYSTEMIC INSECTICIDE, BIS (BIS DIMETHYLAMINO PHOSPHONOUS) ANHYDRIDE. By W. E. Ripper *et al.* (*Bull Entom. Res.*, **40.** 4, 1940, p. 481.) This insecticide is shown to be systemic when sprayed on the leaves of numerous plants. The translation of it from one part of the plant to another, over distances varying from the thickness of a leaf to 3 feet, was shown with *Aphis fabæ*, *Myzus persicæ*, *Brevicoryne brassicæ*, *Macrosiphoniella sanborni* and *Pseudococcus citri*.

Plants treated with it are shown to be toxic to fourteen Aphid species, one Aleurodid, one mealy bug, two Jassids and two species of red spider. It is not found to be toxic to non-plant-sucking insects, notably predators and parasites. It is therefore a selective insecticide for the control of Aphids, and field experiments have shown that treatment with it gives plants prolonged toxicity to Aphids and allows the parasites and predators to keep in check any survivors or newly arrived individuals.

Non-selective organic phosphorus insecticides such a Parathion Paraonon and HETP give a high mortality, but the Aphid population builds up again very rapidly after treatment with them, leading, in many cases, to heavier infestation than before. Plants treated with the new systemic insecticide, however, keep free from Aphids for prolonged periods (two to five weeks, depending on the species of Aphid, the stage of growth of the plant and its physiological condition). Chemical and physical properties and formulations are reported.

The toxicity to mammals has been explored by introducing the poison by various methods, and it is found that the anhydride is not as toxic as Parathion, Paraoxon or HETP, but it is nevertheless a very toxic compound. Feeding trials with treated plant material were carried out on animals, but in no case were any toxic symptoms observed.

Precautions for use in the aeid should include the use of protective cabs on tractors to prevent the spray drift from reaching the operator, and the wearing, by persons handling the concentrate, of overalls and rubber gloves to avoid skin contact.

234. EFFECT OF DUSTING SCHEDULES ON THE YIELD OF COTTON DURING 1947. By J. C. Gaines and R. Wipprecht. (*J. Econ. Ent.*, **41.** 3, 1948, p. 410. From *Rev. App. Entom.*, **37.** A, 11, 1949, p. 424.) Experiments carried out in Texas in 1946 showed that protection of cotton fruits from insect injury early in the season does not necessarily increase the total yield, and additional field-plot experiments with dusts were carried out in 1947 to find the minimum number of applications that could be made for the control of all cotton insects and yet maintain a maximum yield.

Early-season applications of 5 per cent. DDT in sulphur or 5 per cent. DDT, enough BHC (benzene hexachloride) to give 3 per cent. γ isomer and 40 per cent. sulphur did not prevent increases of thrips or increase the yield. Apparently the yield was slightly reduced on plots that received treatments against thrips when the cotton had four to eight leaves; if cotton is forced to set fruit early, this tends to retard vegetative growth and apparently reduces the yield. Calcium arsenate and sulphur (1:2) reduced populations of *Psallus seriatus*, Reut., but was less effective than DDT, BHC and sulphur. The control of *P. seriatus* and *Anthonomus grandis*, Boh., with calcium arsenate during June contributed to increased yields, owing to unfavourable weather conditions for fruit production in early August and the fact that calcium arsenate does not control weevils rapidly, requiring at least a fortnight to do so. When calcium arsenate was used throughout the season, two applications of nicotine sulphate were necessary for the control of the Aphid (*Aphis gossypii*, Glov.) in July and August. The mixture of DDT, BHC and sulphur controlled the weevil quickly and allowed the cotton to fruit again in a minimum period of time. It protected the fruit adequately from injury by *Heliothis armigera*, Hb., late in July. In spite of the fact that there was no control of *P. seriatus* and that weather conditions were unfavourable, the plot receiving six applications late in the season yielded practically as much cotton as those dusted eight or eleven times. These results indicate that it is more profitable to dust cotton with a quick-acting, effective insecticide during the last three weeks of July and August when *Anthonomus* and *Heliothis* are most injurious, than to try to protect the fruit during the entire season.

235. COMPARISON OF DILUENTS IN INSECTICIDE MIXTURES FOR COTTON INSECT CONTROL. By J. C. Gaines and R. L. Hanna. (*J. Econ. Ent.*, **41.** 5, 1948, p. 811. From *Rev. App. Ent.*, **38.** Ser. A, 1, 1950, p. 26.) Since increases in red spider mites (*Tetranychus*) on cotton in Texas were not prevented by certain organic insecticides diluted with clay, talc or pyrophyllite, but did not occur when the mixtures contained at least 40 per cent. sulphur, the effects of several mixtures containing pyrophyllite and sulphur on *Anthonomus grandis*, Boh., *Heliothis armigera*, Hb., *Aphis gossypii*, Glov., and the mites were compared in 1947.

Dusts containing 3 per cent. γ BHC (benzene hexachloride) with 5 per cent. DDT and 40 per cent. pyrophyllite or sulphur, 20 per cent. chlorinated camphene (toxaphene) with 40 per cent. pyrophyllite or sulphur, or calcium arsenate with 33·3 per cent. pyrophyllite or sulphur and pyrophyllite and sulphur alone were applied on June 11 and 23 against *Anthonomus* and six times between July 4 and 29 against *Anthonomus and Heliothis*. The three insecticides were equally effective against *A. grandis*, whatever the diluent, and significantly more effective than the diluents alone. All were significantly better than the diluents alone against *H. armigera*, and the mixtures containing BHC and DDT were significantly better than calcium arsenate, these being the only significant differences between treatments. The Aphid population was significantly higher for calcium arsenate than for pyrophyllite alone, and a little lower for sulphur alone than for pyrophyllite and for the mixtures containing the organic insecticides than for sulphur. The mite populations were about the same on plots treated with the organic insecticides mixed with pyrophyllites, but much lower on those treated with sulphur alone or in the mixtures. Yields were significantly higher on plots treated with the BHC-DDT dust or toxaphene than on those treated with calcium arsenate and were unaffected by the different diluents.

236. FACTORS AFFECTING TOXICITY IN FORMULATING CHLORDAN EMULSIONS. By Y. P. Sun *et al.* (*J. Econ. Ent.*, **41.** 5, 1948, p. 751. From *Rev. App. Ent.*, **38.** Ser. A, 1, 1950, p. 20.) Various factors affecting the toxicity of chlordan in liquid formulations were tested, by diluting emulsion concentrates with water and spraying them at the rate of about 4·5 mg. dilute emulsion per sq. cm. on pieces of squash leaf infested by *Aphis gossypii*, Glov. The living Aphids were counted just before and twenty-four hours after spraying, and the percentages by which their numbers were reduced by the sprays were calculated by the formula of Sun and Shepard; the efficiency figures given below are these percentages. The standard emulsion concentrates used contained 20 gm. chlordan, 77 ml. kerosine as solvent and 10 ml. Atlox 1045A (a polyoxethylene sorbitol mixed fatty acid ester) as emulsifier.

In the first test, in which the concentrate was diluted to 1:1,000, increasing the content of emulsifier from 0·01 to 0·05, 0·1, 0·5 and 1 per cent. by volume, increased efficiency from 13·1 to 26, 80·3, 84·4 and 91·6. The wetting ability of the sprays was poor at emulsifier concentrations of 0·01 or 0·05 per cent., but coverage was uniform at 0·1 per cent., and it was concluded that increase in emulsifier concentration beyond that necessary for the formation of a satisfactory emulsion was needed for maximum effectiveness, the additional emulsifier appearing chiefly to promote wetting and spreading, since further additions of emulsifier after good wetting was achieved produced relatively small increases in effectiveness. The addition to the diluted emulsion (1:800) of 0·02 per cent. sodium lauryl sulphate, which is water-soluble but not oil-soluble, and would be expected to add wetting and spreading properties to the dilute emulsion without radically changing the nature of the emulsion itself, increased its efficiency from 54·5 to 75·9, but further additions of the spreader to give concentrations up to 0·1 per cent. did not appreciably increase its effectiveness, confirming that improved wetting and spreading action was chiefly responsible for the increased effectiveness of emulsions containing more emulsifier than necessary for good emulsification.

In addition to the standard emulsifier, Triton B1956 (a modified phthalic glycerol alkyd resin), Duponol OS (a long-chain alcohol sulphate), Span 85 (technical sorbitan trioleate) and Tween 81 (a polyoxyalkylene ether of sorbitan mono-oleate) were also tested at the same concentration and the concentrates were diluted to 1:500 the emulsifiers mixed well with chlordan and kerosene, but the diluted concentrates varied in effectiveness of emulsification, though this was greatly improved by stirring for about ten minutes. The degree of wetting was about the same for all the emulsions, and there were no great differences in their effectiveness.

237. INSECTPROOFING OF COTTON BAGS. By R. T. Cotton *et al.* (*Text. Inds.*, **113.** 94, 1949, p. 264. From *Text. Tech. Dgst.*, **6.** 11, 1949, p. 874.) Results of a study on the insectproofing of cotton bags, which hold milled cereal products, made under the Research and Marketing Act, are presented. It is reported that cotton bags treated with pyrethrins, alone or mixed with piperonyl butoxide, will protect flour packed in them from insect infestation for at least seven months. The treated cloth is not materially changed in appearance, and its repellency is not affected by exposure to light. Methods of impregnating the bags are also discussed.

238. REPORT OF THE SUB-COMMITTEE CHAIRMAN ON *Verticillium* WILT FOR 1948. By J. T. Presley. (*Phytopath.*, **39.** 6, 1949, p. 499. From *Rev. App. Myc.*, xxix, **1.** 1950, p. 26.) *Verticillium* wilt of cotton is now known to occur through the cotton belt of the United States from the Atlantic to the Pacific. Losses from the disease, though varying from year to year in any particular locality, appear to be constantly on the increase, resulting in the intensification of efforts to develop a *Verticillium*-resistant variety. Workers in California, Arizona, New Mexico, Oklahoma, Mississippi and South Carolina are engaged in breeding acceptable resistant varieties, as well as in selecting tolerant strains.

239. INSECT PESTS OF COTTON IN INDIA. See Abstract 169.

GENERAL BOTANY, BREEDING, ETC.

240. *Atkinsia* gen. nov., *Thespesia*, AND RELATED WEST INDIAN GENERA OF THE MALVACEÆ. By R. A. Howard. (*Bull. Torrey Bot. Cl.* **76**, 1949, p. 89. From *Pla. Bree. Abs.*, xix, **3**, 1949, p. 602.) The author argues that the genera *Montezuma* Sesse and Moçño, *Maga* Urban, and *Armouria* Lewton (*Ulbrichia* Uraban) should be maintained as separate genera and not included in the genus *Thespesia* as suggested by J. B. Hutchinson, of whose classification of genera related to *Gossypium* other criticisms also are made. The material referred to by Britton and Wilson as *Maga cubensis* is placed in a new genus and designated *Atkinsia cubensis*. The characteristics of these and other members of the West Indian group of Malvaceæ and a diagnostic key and descriptions of species are given.

241. ONE OF THE CAUSES FOR CHANGEABILITY IN COTTON PLANTS. By D. V. Ter-Avanesjan. (*Proc. Lenin Acad. Agric. Sci.*, **1**, 1949, p. 23. From *Pla. Bree. Abs.*, xix, **3.** 1949, p. 597.) In Russian experiments deformed seed capsules of the cotton varieties S-15, S-3316, 8802-1, 9621 and 133f have been separated from the normal capsules for comparisons between the plants grown from the normal and deformed seed. The F_1 from the deformed seed showed appreciable differences from the normal varietal plants regarding such characters as raw cotton yield and number of seed capsules per plant, the number of seeds per capsule, length of fibre and height of the plants. The offspring of the experimental plants remained uniform in the second and third year, and retained a definite complex of hereditary characters which distinguished them from the initial variety.

The most marked morphogenetical differences were seen between the initial varieties 962 and 133f and the plants grown from their deformed seed. Comparative descriptions of these are given. Darwin and Timirjazev are cited on the effect of external factors upon the parental organism that can lead to variability. Similar observations have been made on variety 37 of *Vigna sinensis*.

242. Modified Methods for Staining the Primordial Cells of *GOSSYPIUM* Hairs. By A. S. Heiba. (*Stain Technology*, **25.** 1, 1950, p. 39.) Outer epidermal cells of the ovules of the genus *Gossypium* contain fat globules in the cell sap at an early stage of development. These globules disappear gradually as the initiation and development of the hair takes place. Observers dealing with the epidermal cells of the cotton ovules before anthesis often experience difficulty in distinguishing the nuclei from the oily material, owing to the fact that the oil drops cover the nucleus and make it indistinguishable. The author describes a technique which has been found useful in a study to clarify the behaviour of the nucleus of the epidermal cell before initiation of the *Gossypium* seed hairs. Of many fat solvents which were tried, petroleum ether was found to have the least effect on the shape and structure of the cell.

243. The Genetics of Certain Factors responsible for Lint Quantity in American Upland Cotton. By T. R. Richmond. (*Texas Agric. Expt. Sta., Bull.* **716.** 1949.) Seed hairs of cultivated American Upland cotton occur in two layers, fuzz and lint. A mutant seed cover type occasionally arises which has no seed fuzz, but which may either produce measurable quantities of lint or be devoid of lint. The fuzzy and fuzzless seed coat conditions have been designated as " covered " and " glabrous " respectively. The studies reported in this bulletin give the interactions of lint with glabrous and covered seed coat.

244. Cotton Seeds: Pigment Content. By C. H. Boatner *et al.* (*J. Amer. Old Chem. Soc.*, **26.** 1949, p. 19. From *Summ. Curr. Lit.*, xxix, **24.** 1949, p. 486.) Several varieties of Sea Island, Egyptian and Upland cottons showing different characteristics of short, medium or long staple, and low, medium or high nitrogen content were grown under identical conditions, and the seeds obtained were examined for pigment content immediately after harvesting and at intervals during a year's storage. Within the species of *G. barbadense*, the Sea Island seed contained more gossypol and less gossypurpurin than Egyptian seed, but both contained more gossypol and very much more gossypurpurin than did seed of *G. hirsutum.* In all cases the gossypurpurin content of the seed increased during storage, especially over the first two months, but there did not appear to be any relation between the initial content of gossypurpurin and its rate of formation during storage. The content of gossypol (always much higher than that of gossypurpurin) showed different variations on storage in different varieties. The absence of any direct relation between the pigment content and the other varietal or species characteristics suggests the possibility of breeding cotton-seed strains with optimum pigment contents without adversely affecting other desirable characteristics, such as lipin or protein content, or lint quality.

245. How Plant Hormones aid Crop Production. By L. C. Luckwill. (*World Crops*, **2.** 1, 1950, p. 17.) Plant hormones occupy a very important place among the resources of the scientific agriculturalist. In this article the author discussed various ways in which these substances can be used to increase crops—namely, as selective weed killers, in promoting and assisting plant propagation, in producing seedless plants and the control of fruit drop.

FIBRES, YARNS, SPINNING, WEAVING, ETC.

246. An Air Test for Moisture in Cotton. By W. L. Balls. (*J. Text. Inst.*, **40.** 11, 1949, p. 1759.) The author describes the technique and apparatus for testing moisture in cotton. The technique has two components. The first is the method for measuring the moisture content of the extracted air. The second is the method for extracting the air from the cotton and for measuring the temperature of the cotton.

247. Characteristics of Cotton and their Relationship to Certain Properties of Yarn. By D. de Meulemeester. (*Bull. de l'Inst. Text.*, No. 14, 1949, p. 37. From *Text. Tech. Dgst.*, 7. 1, 1950, p. 1.) A critical exposition is given of the methods of measuring the length, strength and fineness of cotton. The work done at the United States Department of Agriculture and Ghent University is discussed and compared. The second part is devoted to bringing out the relationship between the properties of the raw cotton and the qualities of yarn.

248. FINE STRUCTURE OF COTTON FIBRES FROM DENSITY MEASUREMENTS. By H. Wakeham. (*Text. Resh. J.*, **19**. 1949, p. 595. From *Text. Tech. Dgst.*, **7**. 1, 1950, p. 72.) The apparent densities of cellulose fibres in different liquids gives information concerning inner fibre structure which may be useful in characterizing certain desirable properties of cotton fibres. Interpretation is made of some experimentally determined densities of cotton and rayon fibres in benzene and dioctyl phthalate—two liquids differing greatly in molecular dimensions—and in mercury, a non-wetting liquid. In the last case, the "overall density" of a fibre, defined as the average density of all material within the outer wall of the fibre, is determined by a method utilizing a mercury-pressure volumenometer. In the case of the wetting liquids, higher densities were obtained with benzene, which has the smaller molecule; this indicates that the fibres have pore spaces which in size approach the dimensions of the molecule. When the cotton fibres are cut into short sections, about 1 mm. long, more of these pores and intrafibre channels are open to the liquid medium; a higher density is therefore obtained for the cut fibres than for the whole fibres. Pore-space values within the fibre are calculated and compared with values obtained by other methods. The significance of these observations in the consideration of fibre structure is discussed.

249. COTTON AND RAYON YARNS: SIGNIFICANCE OF LEA STRENGTH MEASUREMENTS. By H. A. Vreedenberg. (*Textielwezen*, **5**. 6, 1949, p. 33. From *Summ. Curr. Lit.*, xxix, **24**. 1949, p. 481.) It is shown that conclusions as to the irregularity of a single yarn can be drawn from lea strength measurements only if the average strength of the yarn is known. The relation existing between yarn irregularity, number of breaks, lea strength, and average strength can be derived by means of probability calculations, after making two assumptions on the breaking strength of the single yarn which are confirmed by tests on rayon yarns. The calculations permit a comparison to be made between the efficiency of the method based on lea strength measurement and the direct determination of yarn irregularity. The lea strength method is only to be preferred for very regular yarns.

250. RELATION OF SIX ELEMENTS OF COTTON QUALITY TO STRENGTH OF 22S YARN (REGULAR DRAFT), BY CROP YEAR, VARIETY AND STAPLE LENGTH. By R. W. Webb *et al.* (U.S.D.A., Prodtn. and Marktg. Admin., October, 1949.) This report is the seventh to be made in a study of relationships of cotton-fibre properties to manufacturing performance and quality of manufactured product. Skein strength of 22s carded yarn, processed on conventional or regular draft roving and spinning equipment, is reported in relation to upper half mean length, uniformity ratio, fibre fineness (weight per inch), fibre strength, percentage of mature fibres and grade.

The study is based on 824 cottons included in the Annual Variety series for four years, 1941-44. All are of the American Upland type. They represent not only the leading varieties in commercial production during that period, but also included some special cottons not in commercial production. The data on these cottons are classified by years, varieties, individual staple lengths and by staple length groups.

251. STUDY OF THE BLEACHING OF BLUE COTTON FIBRE. By R. E. Hudson & H. M. Waddle. (*Text. Resh. J.*, **19**. 1949, p. 421. From *Text. Tech. Dgst.*, **6**. 11, 1949, p. 895.) The apparent cause and location of the colour in blue cotton was studied. It was found that the blue colour is probably developed through fungal action on the protoplasmic residue in the lumen of the fibre. The controlling factor in the bleaching of blue cotton is the lack of access to the blue colour in the lumen by the treating solution. Diffusion of the blue coloration through the fibre appears to occur slowly when the fibre is placed in a mildly alkaline bath at elevated temperatures.

Printed in Great Britain by
Billing and Sons Ltd., Guildford and Esher

THE
EMPIRE COTTON GROWING
REVIEW

VOL. XXVII JULY, 1950 No. 3

BREEDING MILLIONS IN EGYPT

BY

W. LAWRENCE BALLS, C.M.G., C.B.E., Sc.D., F.R.S., F.T.I.(Hon.)

The disturbance of world markets by Government trading and currency troubles has obscured the relation between price and quality. By 1939 the work of H. A. Hancock had made the measurement of this relation for Egyptian cottons; world price and yarn strength were practically synonymous for Egypt; the lea-tester for our standard spinning test might almost have been calibrated in dollars, and the relative selling price of any new variety was known several years before it ever reached the market.

Also, our colleagues at the Cotton Research Board had elaborated the routine measurements of relative yield for the new varieties which they bred, by passing them through miniature chequers, botanical section chequers, and agronomic yield chequers, until this difficult determination was sufficiently good to match up with the spinning data. Consequently, the relative value of each variety in Egypt was entirely familiar in terms of pounds sterling per acre.

Hancock compressed a mass of experimental data into a few pages

Delta Cotton Varieties: Relative Crop-values per Acre

Giza number	*Name*	*Lint yield (Lb. per acre)*	*World Price (Pence per lb.)*	*Value per acre when Zagora is 7½d.*
39	Amon ..	430	11·65	£20·8
26	Malaki ..	454	11·05	20·9
4	Sakha Four ..	449	9·75	18·2
"310"	Sakel	373	10·50	16·4
29	Karnak ..	573	10·35	25·2
7	Giza Seven ..	605	9·00	21·6
36	Menoufi ..	640	9·90	26·1
12	Wafeer ..	632	8·50	22·3
—	Maarad ..	520	9·85	21·3
—	Fouadi ..	586	8·60	21·0
19	Zagora (Ashmouni)	640	7·50	20·0

entitled "The Cottons of Egypt,"* and the table overleaf is rearranged from his Table V therein, with the addition of later data for Amon.

The writer used these data in 1939 to make an evaluation of the profits which Egypt had derived from cotton breeding at that time, and attempted a forecast of the situation for seven years ahead, as is necessary in applied genetics. The details of the forecast were completely falsified by war, but the end-result was the same financially. It should be of some interest to present the forecast as well as the actual facts, since the former was a reasoned consideration of the reactions of the spinner, on the one hand, and the grower on the other, to the better quality and better yield of the varieties then under process of development, our objective being a well-balanced supply of all qualities, made from such pure lines as gave a secure long-term profit to the cultivator. It should be added that, to quote Hancock, "No one is ever forced to adopt these new varieties, released only after years of trial to ensure that they will show a profit to cultivators adopting them."

Forecast of Varietal Changes

The areas devoted to each variety each year in the Delta are shown in Fig. 1 as percentages of the Delta area. They are arranged in order of quality: low-quality Zagora (which is Ashmouni grown in the Delta) at the bottom, rising to super-quality Malaki (with Amon later) at the top. The fade-out of Sakel in competition with more profitable Zagora is very clear, and it is evident that the introduction of Giza Seven as a stop-gap measure saved Egypt from becoming predominantly a producer of inferior cotton—inferior, that is, by Egyptian market standards.

The appearance of the thin edge of the wedge of Giza Seven, and its rapid thickening, has administrative interest. There was a quarter-acre of this strain in 1926, a year after the beginning of Fig. 1; the decision to concentrate on its development was taken in the winter of 1927-8. All available seed was utilized by dibble-sowing in the early stages of propagation, and by 1933 it had become a thing of minor interest at Giza, this being the time when its market importance was becoming evident. Thus this diagram shows how all cotton breeding has to look at least seven years ahead.

From then onwards the expansion of Giza Seven downwards squeezes out the inferior other varieties below it (Pilion, Fuadi, etc.), and checks the expansion of Zagora. In the upward direction it expands at the expense of Sakel, which the table given above shows to be much inferior in value per acre, while the special-purpose wilt-proof Sakha Four, with Maarad, retain their percentages unchanged. Their slight inferiority in acre-value is balanced by cultivation for high grade and the demand for high quality.

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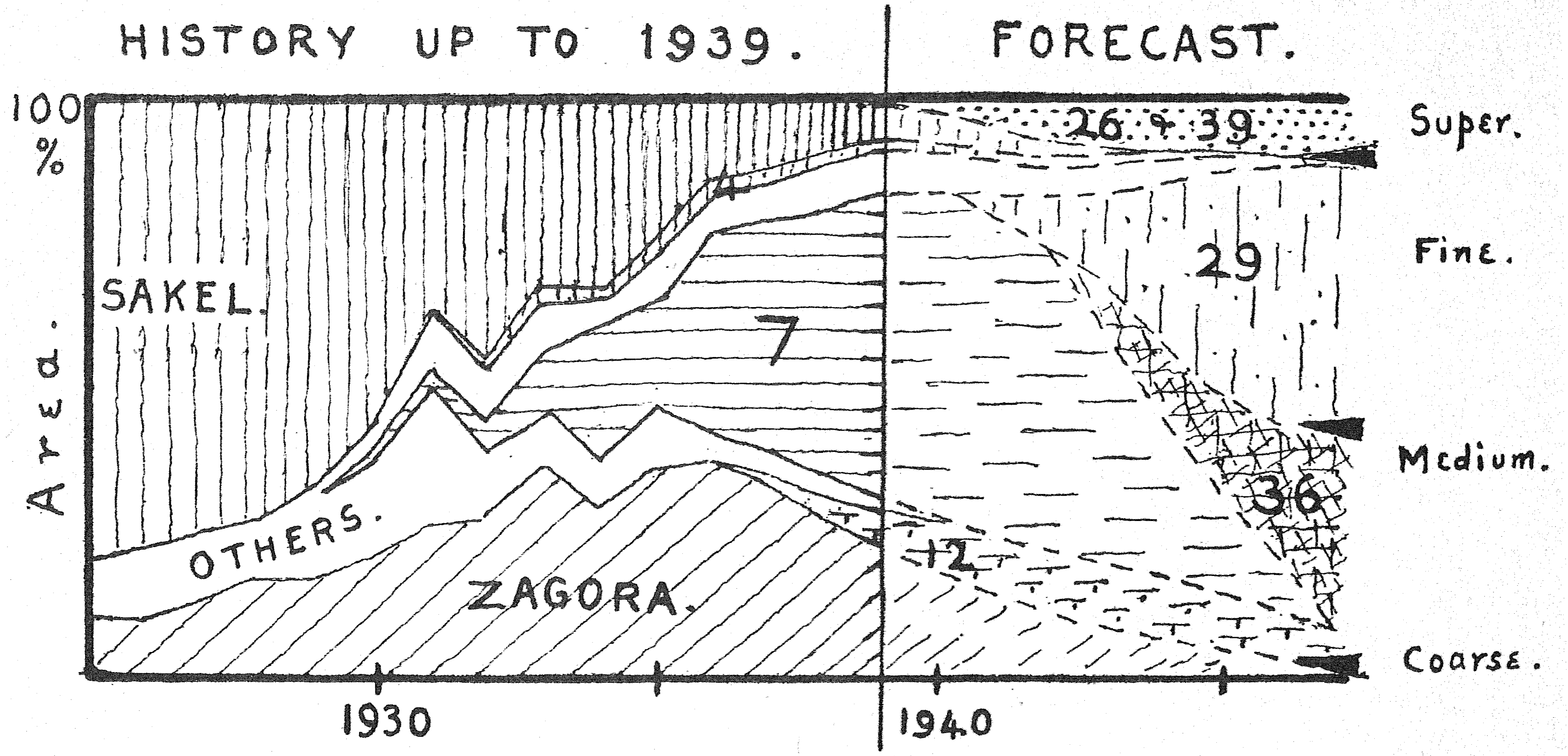
* *Min. Agric. Egypt, Tech. Bull. No.* 235, 1939, and 2nd ed., No. 235A, 1946.



Areas under Cotton Varieties in the Delta of Egypt.
Reference: a Circulated Paper for the Cotton Research Board—1939.

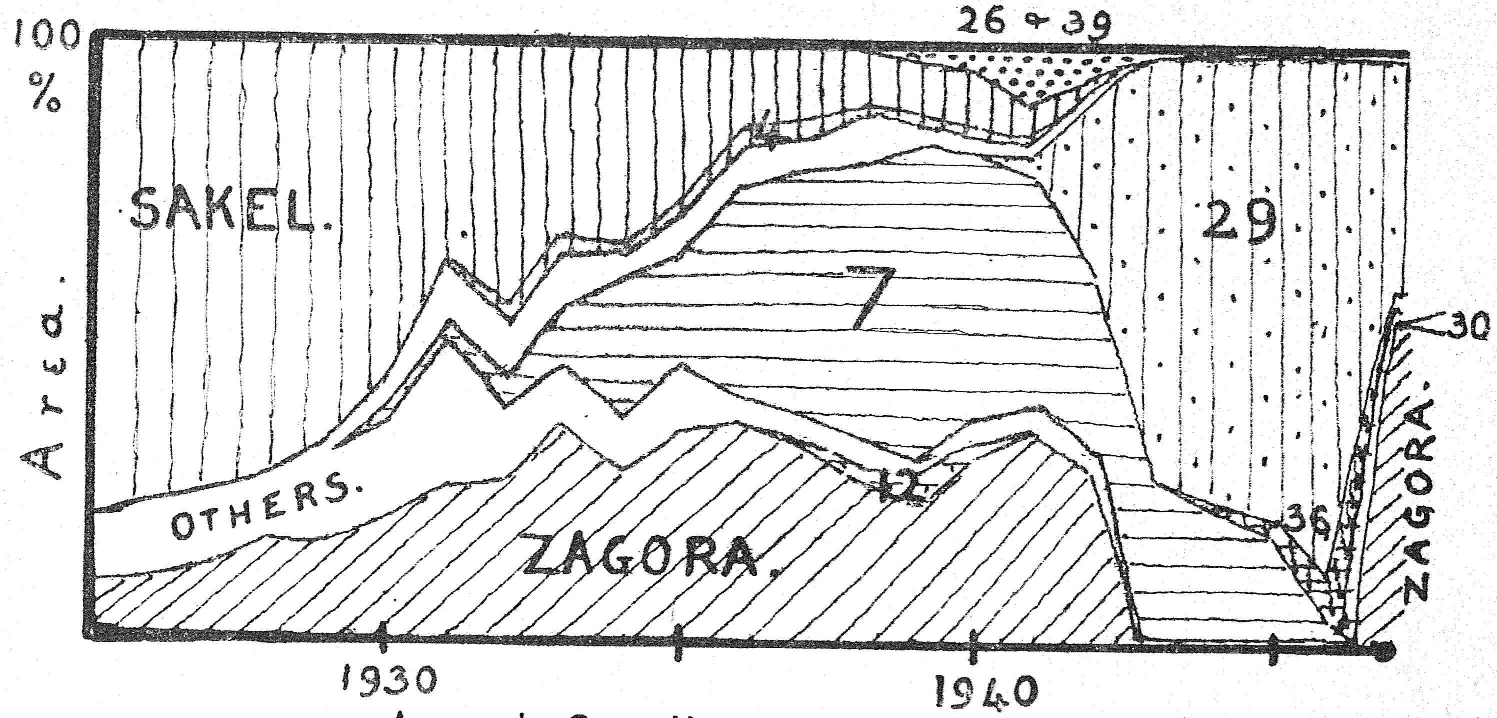
Fig. 1.

The extension of Fig. 1 into a forecast shows how this demand would have been satisfied without loss of acre-value. Giza Twenty-nine is practically Sakel from the spinner's viewpoint, and it is shown as exterminating Giza Seven in consequence. A big wedge of super-quality cottons typified by Giza Twenty-six was becoming available, with improving acre-value, and the top of the world cotton market was already in sight, bettering Sea Island strength without the inconvenience of very long staple. At the bottom of the diagram Zagora was expected to disappear completely from the Delta as the victim of Giza Twelve (another stop-gap product), and this in its turn being displaced by Giza Thirty-six, whose superiority in value per acre foretold a rapid expansion, thus leaving the production of relatively weak cotton to be concentrated in the Ashmouni crop of Upper Egypt. As a reminder that the varieties mentioned are only stages in further possible developments, three black wedges for varieties yet unknown were drawn as projecting into the further future.

ACTUAL CHANGES OF VARIETIES GROWN

So much for prophecy in 1939. The actual changes shown in Fig. 2 under the limitations of wartime conditions, and their aftermath, were much simpler and were quite adequate to those conditions. Zagora was abolished by legislation for four years, concurrently with a big reduction in cotton acreage generally, in order to make room for more summer food crops; incidentally, this disturbance of the proven system of crop rotation caused a steady fall in the yield of cereals until the extra acreage was nearly cancelled out. Giza Twelve vanished along with Zagora as forecast, but much more quickly. The super-qualities were invaluable for a season or two, and went up in kite balloons, but subsequently shrank surprisingly and disappointingly, in what is probably an ephemeral lack of demand, at the price asked. The undoubted merits of Giza Thirty-six were about five years overdue in getting recognition, for the cultivators were Karnak-mad, and under that name our Giza Twenty-nine spread almost to mono-culture. The development of a short useful cotton called Giza Thirty, which fills the quality-gap between Zagora and the other Delta cottons, is only just beginning at the end of Fig. 2.

The die-away of Giza Seven happened rather more quickly than had been forecast, and quite rightly. The prophecy was based on considerations of competitive demand, but at a later date we found that this strain was deteriorating, because its nucleus stock had once been renewed in the early thirties with open-fertilized seed, in misguided disregard of "theory." The mills of God grind slowly, and so do the "unwanted genes," at first. A temporary boom in Zagora on its release from restriction in 1947 was the natural market reaction to previous scarcity.



Areas under Cotton Varieties in the Delta of Egypt.
Reference: Official statistics, 1925-1947.

FIG. 2.

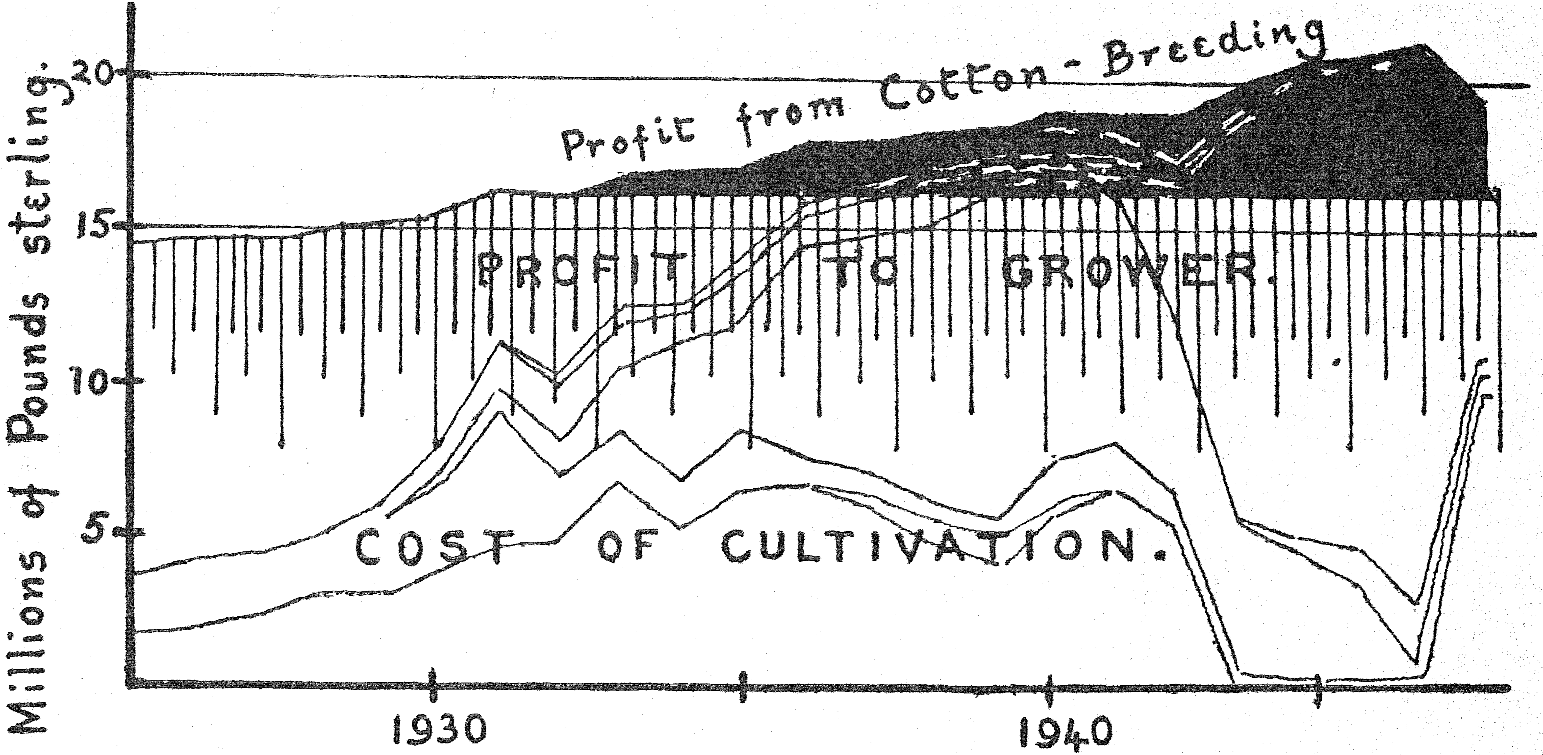
The Value of the Crop

The value of the crop in a stable world of fixed acreage, yield, price and grade is portrayed in Fig. 8. The variations of total Delta acreage were eliminated in the previous diagrams, and in this one the total is taken to have been constant at 1,200,000 acres; the boundaries for the varieties are shown in the same relative positions as before, but without notation. The price of Zagora used to be around 7½d. per lb.; this is also assumed to have been constant throughout, and the price of the other varieties can be related to this through the table already given. The yield is also assumed to have been steady for Zagora at 500 lb. of lint per acre, and the others again in proportion. These values for acreage, yield and price are approximately those which actually existed round about 1930. Any financial conclusions drawn from them are thus not likely to be in error from over-statement; Karnak, which is here valued at less than 10½d., rose to the neighbourhood of 5s. during 1947.

Adding up the crop-values computed for the acreages under each variety during each year, as in Fig. 8, shows that for the first six years after 1925 the total value of the Delta crop was almost steady; there is a slight rise due to the pernicious tendency to substitute Zagora for Sakel. Pernicious, that is to say, in the sense that it weakened the special position of Egypt in the world of cotton supply by bringing the average of her product nearer to that of unspecialized countries.

The first increase in value due to the introduction of Giza Seven becomes apparent in 1933, the Zagora fraction has begun to decline, and any further rise in the total value is due to the work of the cotton breeders. This portion of the diagram is marked in solid black, and shows that £5,000,000 was thus added to the value of a £16,000,000 crop in fourteen years. The profit is quite disproportionate to the expense, as may be seen from the fact that even in 1931 the profit to Egypt from Giza Seven was estimated to have repaid every piastre which had been expended on cotton breeding since Mendelian investigations started in 1905.

This striking increase in total value is not the whole story, and in Fig. 8 we have attempted to depict a further fact—namely, that this improved value of the crop has a still better appearance from the viewpoint of the individual cultivator. Part of the farmer's selling-value for his crop has goné from him in costs of cultivation, whether he be a smallholder or a big landowner. These costs are in the long run the same for both, whether they be reckoned as rent of land or as interest on land-value; as time spent in labour or in wages paid for labour; as costs of seed, manure, fodder and the like. Exact determination of the cost of cultivation is almost impossible, but under the conditions



Area 1,200,000 acres, with Zagora yielding 500 lb. at 7½d.
Reference: Table V in "The Cottons of Egypt," by H. A. Hancock.
Values of the Delta crop in a stable world; area, yield, and price fixed.

Fig. 3.

we have prescribed it will lie somewhere between £8 and £12 per acre. The diagram has therefore been shaded with parallel lines of varying length to indicate that only its upper part can be considered as "Profit to the Grower." In drawing these lines we have assumed that the higher value per acre achieved by better yield and better quality does not, other things being equal, increase the cost of cultivation. This was in order to simplify the diagram, and it is not strictly true, since picking costs, ginning charges and the like are increased, but only as a small fraction of the total. So, when we compare this shaded area with the blackened area, we reach the remarkable conclusion, by calculation from the published facts, that the general result of cotton-breeding activities at Giza has approximated to a doubling of the profit obtained by the grower of cotton in the Delta of Egypt.

Conclusions

The methods of investigation, agronomy and seed control by which this has been done are now fairly comprehensive. The weak spot lies in the determination of yield. Years ago one used to trust the skill and instinct of the plant breeder to identify the potentially high-yielding parents in a population. This was refined by S. C. Harland* to a sorting-out of the morphological components of yield, and the writer examined it physiologically. Nevertheless, the end-result was much the same as the starting-point—namely, that the standard deviation of yield per plant is about 35 per cent., and therefore the yield of any one plant has no genetical meaning by itself. Incidentally, though similar considerations apply to quality measurement by yarn strength, the standard error is much lower, but still so high that although single-plant spinnings are now possible they can have little significance. The elimination of soil variation, equally with this variance of the individual, can be done only on a population of plants, and during this extra generation there may be segregation, which starts the inquiry all over again. Thus the outstanding problem for the modern cotton breeder is not so much genetic as physiological. Methods are wanted which will diminish the variance from plant to plant, as by dibble-sowing and by growing in artificial homogeneous "soils," as well as measuring and analysing it with plant-development methods. The cost appears prohibitive, but it might save three years' work out of every five and so pay for itself.

Though there is need for a more rapid and precise method with which to predict yield under various soil conditions within the climate of irrigated Egypt, to match up in early stages with the prediction of market value, there is as yet no sign—or, more correctly, there was no sign in 1947—of any limit to further improvement of the Egyptian varieties. Quality advances are still appearing in crosses derived from

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* Harland, S. C., *West Indian Bulletin* 17; 145-161; 210-236.

Sakha Three, and although the soil and temperature of the Delta does not permit of such response to manuring from the existing varieties* as obtains in Upper Egypt, where an average of 700 lb. of lint per acre was reached in 1944, there are further possibilities of genetic adaptation to Delta conditions, by bracketing genetics with physiology.

The general plan of pure-line seed supply with annual renewal from protected nucleus stocks was the writer's contribution, as also was the preservation and use of the queer Sakha Three strain for strength parentage. The breeding and field work was done by the staff of the Botanical Section in the Ministry of Agriculture, supervised since 1926 by C. H. Brown. Co-ordination of their data with his own revolutionary improvements in spinning technique was the work of H. A. Hancock after 1932. Before his death, in 1947, he had investigated the pedigree records of every renewal stock; devised a safe routine for the purity maintenance of such stocks—which the writer had failed to do; introduced actual spinning as the qualifying test for permission to sow any seed under the existing seed-control law; analysed the possibilities of multi-gene inheritance by making his micro-spinning test into an advance of method comparable to an electron microscope; and used his statistical skill to condense everything into an intelligibly small compass.

* Gracie, D. S., EMPIRE COTTON GROWING REVIEW, April and July, 1950.

Received March, 1950.

"PAMBA"

BY

NORMAN F. SPURR

EACH one of us reading this article is probably affected in some way or another by "Pamba." We may grow it: we may spin it: we may be engaged in research upon it; or we may wear it. It is the Luganda name for cotton. I didn't know this until I visited Uganda in 1949 and found that the African grew it. But "Pamba" will recall for me something more than the traveller's scene, because it is also the title of an instructional film I made showing how to plant cotton correctly. This sounds simple, and in many ways it was simple, but . . .

Improved agricultural methods are far easier to devise than to root in the tradition of an agricultural community. This is almost axiomatic. Nowhere is this more true than among an African peasant community. Extension methods, therefore, ought to have a high priority in any policy concerned with agricultural improvement, and every endeavour should be made to improve the existing techniques. G. B. Masefield made this point in an excellent article on extension methods published in the *East African Agricultural Journal.*

Of recent years visual aids have played an increasingly important part in teaching, and not the least important of these aids has been the film. For a number of years I have been engaged in making educational films, and in 1949 I found myself in Uganda as Territorial Films Officer for the Colonial Film Unit. Making films for peasant Africans was not new to me, for I had made films, used films, and undertaken research into the reactions of audiences to films in Nigeria. Naturally experience brought to light recurring facts, and these were formulated into theories.

In Uganda the Public Relations and Welfare Department had also formulated theories about extension work in general and were busy working them out. Perhaps amongst a number of contributions the most original was the creation of a strip-cartoon character called Kapere. Each week the P.R.O. vernacular press published a four-picture strip of Kapere's adventures. Kapere was instantly recognized in any group because of his loud check shirt and dark glasses. He invariably appeared as the victim of his own stubbornness, conceit or disobedience. Kapere always knew best, and how wrong he often proved to be! P.R.O. through its Welfare Section under Mr. R. Savage also provided touring demonstration teams. They toured the countryside as spearheads of departmental propaganda, interspersing their teaching with entertainment, and in their plays combining the two. It was not dull propaganda, for often it was clothed in the lilt of a song or the humours of a burlesque, and of course in the hapless form of Kapere.

Mr. G. Wrigley, the Agricultural Officer, Buganda, was so keen on extension work and the use of visual aids that I had hardly set foot in the country before he was on the doorstep to find out what we could do for him. Time deepened my first impression of good fortune, for in Wrigley I met a man who had, in my view, the proper attitude to visual aids—that is, these were not to replace him, but to be his servants. Wrigley wanted to use film to hasten and deepen the impact of his own work. What more obvious than a film for the Agricultural Department on Uganda's major cash crop?

We were fortunate in having an aim ready made, for a broadsheet, written in Luganda, had already been produced with its theme the proper planting of cotton. We both believed that humour, even to the point of ridicule, had been sadly neglected to date in films for peasant Africans, and naturally our thoughts turned to Kapere. There was already in circulation a playlet on cotton planting with Kapere as its central character. This play was being very well received when put on by the demonstration teams, and I went with Wrigley and Savage on an unforgettable journey across country to see it performed. Following native footpaths, we took one and a quarter hours to go two miles, chancing the hazards in a way which would have made the manufacturer of the car swoon from shock. Alas! my worst fears were confirmed; for the play, being a play, depended upon dialogue rather than action for its humours. I had no facilities for making synchronized sound films, and so had to think again.

During three years of making films for African rural populations I had come to the conclusion that the best method of presentation was by the narrative-teaching film. George Pearson, associate producer of the Colonial Film Unit, one of the pioneers of the British film industry, and a man of remarkable insight and genius, had always insisted upon the importance of a story as a vehicle of instruction, and the narrative-teaching film was in direct line of descent. My first production, using this technique, was in Nigeria. (The subject of the film was cocoa preparation and the film was called *It Pays to Take Care.*) What is a narrative-teaching film? It is more than a story with a moral, for although it sets out the problem in human terms, the answer to the problem is given by direct teaching techniques within the film itself. How is this worked out in *Pamba?*

First we accepted our inability to get away from the hoary old formula of the good versus the bad, but there was no good reason why we might not clothe the familiar in some new garments. Our purpose was to persuade rather than order, and so our bad farmer was bad through ignorance rather than through indifference, for we wished our audience to be sympathetic towards Daudi. At the same time there must be no mistake about the bad methods which he employed. It so happens that many a Muganda employs a porter to work for him, and more often than not they are insufficiently supervised. Here then was a character we needed—a porter. He was to be shown taking advantage of the slackness of his master by so far neglecting his duty as to be caught drinking beer when he should have been working. He was to be shown planting seed up and down the slope and in great handfuls, pressing the seed into the earth with his feet, a practice by no means extinct, and so on. Suddenly Wrigley turned to me and said, " Why not make him Kapere?" Why not indeed! And so our porter became Kapere with his dark glasses, loud check shirt and tradition of ineptitude.

A script was written and arrangements made for shooting. Our story was a simple one. Daudi, an indifferent farmer, had been found out by a bad season and is short of money. He comes to Makasa, the good farmer, to sell a goat. Makasa's new bicycle, a symbol of prosperity, leans against the wall and Daudi pauses to examine it, for he has always wanted one. Makasa is weeding and is too busy to come at the time, and Daudi is astonished to see the size of the cotton plants, the regular spacing, their quality, for his own seed is not yet in. When Makasa comes to Daudi's house to buy the goat he is asked to give his advice, and upon arriving at the plot Daudi's porter is caught drinking beer. Makasa is shocked by the primitive methods employed and sets about showing Daudi how to plant correctly.

Our first task was the casting of our characters. Fortune favoured us in that the African Agricultural Officer in charge of the area, Mr. Mutaganaya, found two farmers who were willing to co-operate and were sufficiently different in looks and dress to make our point. They also owned houses which were different in size and appearance. The cotton plants shown in the film actually belonged to the " bad " farmer, but of course only those who made the film knew this. Daudi's plot was part of a large piece of land owned by an Indian who intended to grow tea upon it. We chose this location because it was on a slope and near uncleared land. Kapere we borrowed from the P.R.O.

Then came trouble. Kapere could be borrowed for only a short time and his appearance coincided with a break in the weather. No longer did we have the clear sky and shining sun, but bright overcast. This is not so serious with dark-skinned people, as it cuts down the contrast range of the scene which is always difficult to handle, so we were not unduly worried.

Film-making, as you are well aware, is a seemingly cock-eyed business, and so it will come as no surprise to learn that we shot the film back to front, starting with the final sequences in which Kapere appeared. Kapere was the only member of the cast of three to speak English, and proved to be most difficult to handle. In part this was due to the fact that the whole of his experience had been as an actor in plays, but re-take after re-take became necessary until tempers frayed and mole-hills became mountains. Experiences such as this tend to undermine one's faith in small mobile units for producing films of this nature, and yet it is the only way within the bounds of practical economics. But then things go right again, and one's faith is restored. It is not only the cast who suffer from " temperament "!

With the last part finished we started on the first part of our film. This was considerably easier. The weather was again fickle, but this time we could afford to indulge in the time-hallowed pastime of film-making out of doors—waiting for the sun.

The 16-mm. film on which the production was photographed was sent to the United Kingdom for processing and a copy was returned in almost record time. After viewing the material, it was assembled in order and viewed again, and then tried out with an audience. One of the most interesting reactions would be that of the audience to Kapere. Would he be recognized the moment he appeared on the screen? Would the audience laugh? The film had a commentary to it, but no mention was made of the name Kapere until considerable time had been given for recognition from the visual material alone—that is, the dark glasses and check shirt. The staccato note of the mobile generator told us all was ready, and through the darkness there stabbed a beam of light which unfolded upon a white screen, hanging from the wall of a hut, the story of " *Pamba.*"

The first to recognize Kapere were the school children; these were the literates, the people for whom the press was a means of communication; but then, by degrees, the whole audience realized who this strangely familiar character was meant to be—" It's Kapere."

Wrigley and I parted company in our interpretation of the results. Wrigley thought the pace of the sequence which showed Kapere being flung out of his hut, beer gourd and all, was too slow and that this was the reason why Kapere's first appearance was not greeted by a yell of laughter. I thought it was due to the lack of immediate recognition of a character translated from one medium to another.

The whispered " It's Kapere " was rather like a child convincing itself of some obvious truth. Not, of course, that this made any difference to the impact of the lesson of the film, but only to the full appreciation of its humours. By the time the end of the film was reached and Kapere chased off the plot to the comment, " If you employ a Kapere, or use Kapere-like methods, there is one good rule—get rid of them," our audience was fully appreciative of the comedy.

Now, in matters of opinion it is short-sighted policy to be stubborn, so we decided to re-take the scenes about which Wrigley held such strong views. I was sceptical, as I felt that the extra cost would not be justified by the results, for although it might improve the scene it would not enable Kapere to be more readily recognized and so gain instant laughter because of that, for this depended upon factors outside the film.

We re-took our shots, assembled them, and tried the film again. This time Wrigley was more inclined to my point of view, and I certainly thought the improvement in pace well worth the trouble and cost, for comedy thrives on pace.

It will be impossible to find out the effect of *Pamba* until a planting season has come and gone, but whether it fails or succeeds there is no question that in the film we have a most potent instrument for the communication of ideas into the life-stream of rural peoples at their most vulnerable point; for seeing is believing. The problem in our colonies is the problem of a multitude who have much to learn as a changing world attacks the very roots of living, and yet there are too few teachers. The film, properly used, and with appropriate techniques born of the class-room rather than of the entertainment world, may well become an important answer to this problem of how to teach quickly and yet surely. I believe the film can do this.

Received April, 1950.

AN ANALYSIS OF THE FACTORS WHICH GOVERN THE RESPONSE TO MANURING OF COTTON IN EGYPT

BY

DAVID S. GRACIE

PART II

INTERACTIONS OF NITROGEN

THE unconventional nature of the main interaction of nitrogen—viz., that large returns from it can in general only be expected where a high level of yield already exists—has been illustrated from the seasonal averages in Fig. 5. It is also evident in Fig. 1B where the average yields (including the effect of 3N) in the experiments are compared with those for the whole country. The departure from the line of equality in the diagram increases as the yields become higher; the amount of nitrogen used in the experiments is larger than for all Egypt, and its efficiency will increase as the level of yield rises. Anything, in fact, that raises the yield level will tend to increase the efficiency of added nitrogen;* there is, of course, at the same time no suggestion of there being a constant relationship in the matter.

NITROGEN AND LOCALITY

When the average effects from nitrogen were given above the separation of the results for Upper and Lower Egypt showed that the higher average yield without manure of the former region was associated with a larger return from its application. The examination of this locality effect has been extended by grouping the Delta experiments according to latitude and season. The results are then averaged, giving equal weight to the experiments within each group, and equal weight in turn to the average of each group in each season. This has been done separately for the nine years from 1931 to 1939 and for the seven years 1940 to 1946. From 1942 onwards the area under cotton was restricted, and the crop would tend to be confined to the better land with the possibility of better yields and responses; the picture given by the results of the first period may therefore be the more correct:

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* A very good illustration is also found in the tendency, evident in some years, for high standard error to go with low return from nitrogen; response is lower on low-yielding (deteriorated) land on which random error can at the same time be expected to be high.

Locality	*Period*	*Number of Experiments*	*Kantars per feddan*		*Maximum Increase as % of Control Plot Yield*
			Average Control Plot Yield	*Average Maximum Increase*	
North of 31° 00′	1931-9	64	4·43	1·34	30·2
	1940-6	51	5·21	1·64	31·4
Between 30° 45′ and 31° 00′	1931-9	50	5·29	1·60	30·2
	1940-6	39	6·42	1·92	29·9
Between 30° 00′ and 30° 45′	1931-9	70	5·99	1·70	28·4
	1940-6	45	6·11	1·81	29·6
Upper Egypt, *i.e.*, south of 30° 00′	1931-9	77	6·16	2·01	32·8
	1940-6	95	5·91	2·60	43·9

With seasonal variation eliminated there is a progressive increase during the first period in both control plot yield and maximum increase from fertilizer as one moves from north to south, which would be expected. In the second period the highest average control plot yield is recorded in the middle of the Delta, but the highest average increase from nitrogen is always obtained in Upper Egypt. Except for the purpose of comparing it with varietal effect below, little attention is paid to the fact that the average maximum increase is roughly a constant proportion of control plot yield anywhere in Lower Egypt; the further subdivision of the experiments which is made later under "Practical Application" will show that the increase obtainable is very far from being in such constant proportion, whether in Upper Egypt or in the Delta.

NITROGEN AND VARIETY

With the exception of Ashmouni, which is synonymous with cotton growing in Upper Egypt, the distribution of varieties with time is very unequal, so that results are not really comparable. Karnak was only grown in the second half of the period and Giza 7 mainly in the first. Sakel made its last appearance in one experiment in 1937 and Sakha 4 in two in 1940. But variety is in any case inextricably confounded with locality; there is a similar association in the Delta between control plot yield and maximum increase as with locality, with the higher-yielding varieties responding more to manure, but all again roughly in the constant proportion of 30 per cent. Response, whether expressed as kantars per feddan or as a proportion of control plot yield, is greatest with the variety Ashmouni, *i.e.* in Upper Egypt.

NITROGEN AND THE PREVIOUS CROP

Cotton is chiefly grown after maize, bersim* catch crop and rice. The experiments recorded as having been conducted after each of these crops have been averaged, giving equal weight to each season:

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* Egyptian clover.

Previous Crop	*Number of Experiments*	*Kantars per feddan*			*Average Maximum Increase as % of Control Plot Yield*
		Average Control Plot Yield	*Average Maximum Increase*	*Total Production*	
Maize ..	226	6·03	2·10	8·13	34·8
Bersim c.c.	102	5·77	1·73	7·50	29·9
Rice ..	65	4·61	1·73	6·34	37·5

Total production is lower after bersim than after maize, and lowest after rice, while response to nitrogen is proportionately greatest after rice and least after bersim. The differences are real and are due to differences in locality (rice), sowing date (bersim) and low available nitrogen in the soil (rice); they are more fully analysed below under "Practical Application."

AVAILABLE SOIL NITROGEN

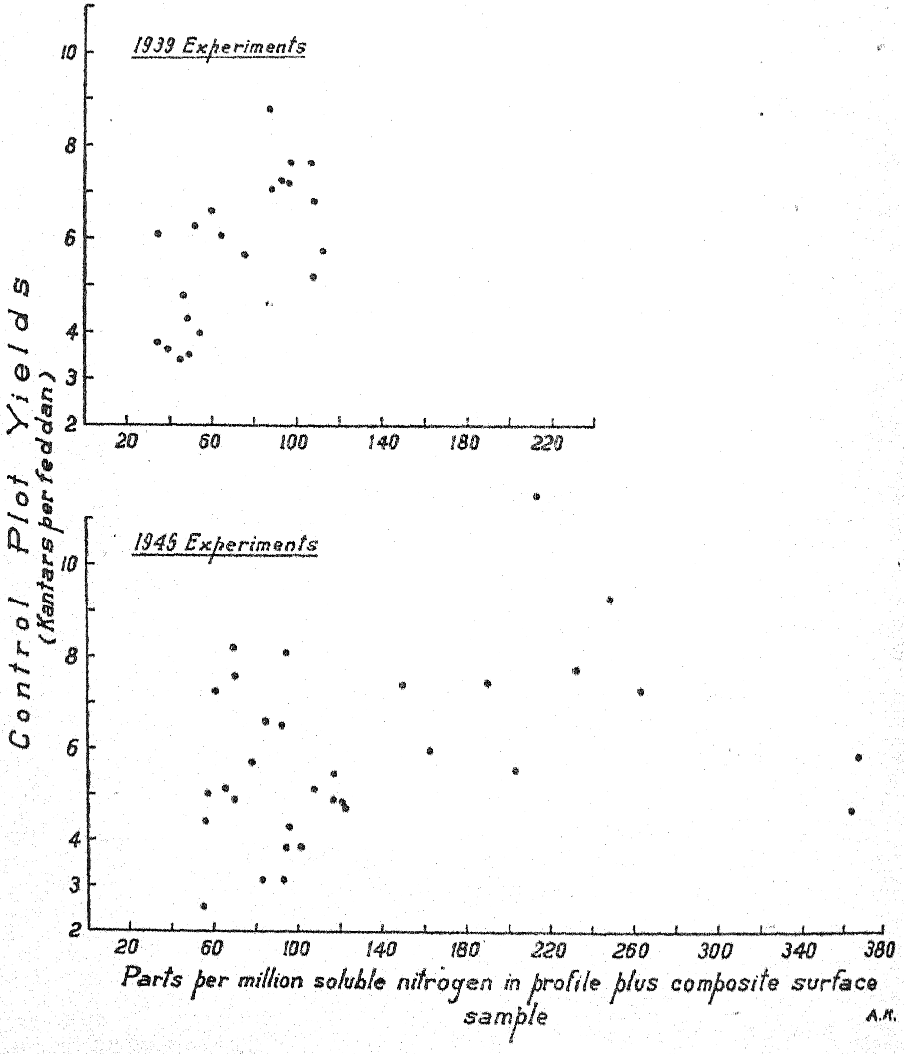
To obtain an estimate of the nitrogen available two separate determinations were made in the laboratory on the soil samples taken from the experiments. The first is a measure of what is called "soluble" (ammoniacal and nitrate) nitrogen and the second measures the "hydrolysable" nitrogen. The former is what is extracted by leaching the air-dry soil with normal sodium chloride solution, and the latter what is brought into solution by heating the soil under standard conditions with dilute sulphuric acid. The hydrolysable nitrogen is regarded as a measure of the mobilizable nitrogen in addition to the ammoniacal and nitrate nitrogen. The two fractions together form the "available" nitrogen.

No connection between the available nitrogen and the recorded yield was found until the soils were sampled at the time of thinning; estimates made on samples taken at the time of sowing can have no meaning. Thinning takes place about a month and a half after sowing and it is then that any fertilizer nitrogen given is usually applied. The actual sampling dates will therefore vary according to locality and season, but they will roughly all be at the same stage of development of the plant. The soluble nitrogen then present plays a consistent part in determining the size of the control plot yield, while the larger the amount of the hydrolysable nitrogen fraction, the smaller is the response to manure. The former relationship is the more pronounced; it is illustrated in Fig. 9 from the 1939 and 1945 experiments.

The amount of available nitrogen and the extent to which the crop depends on it is just as much subject to seasonal influence as is the efficiency of fertilizer nitrogen. This is brought out by the average

Fig. 9

RELATIONSHIP BETWEEN SOLUBLE (AMMONIACAL AND NITRATE) NITROGEN AND CONTROL PLOT YIELD



figures for available nitrogen present at thinning in the various years, and especially by the amounts respectively present at sowing and at thinning in 1938 and 1939. These two seasons were contrasted in that the months of March and April were very much colder in the former year:

AVAILABLE SOIL NITROGEN AT SOWING IN 1938 AND 1939 AND AT THINNING FROM 1938 TO 1946

(Parts per million in profile plus composite surface sample)

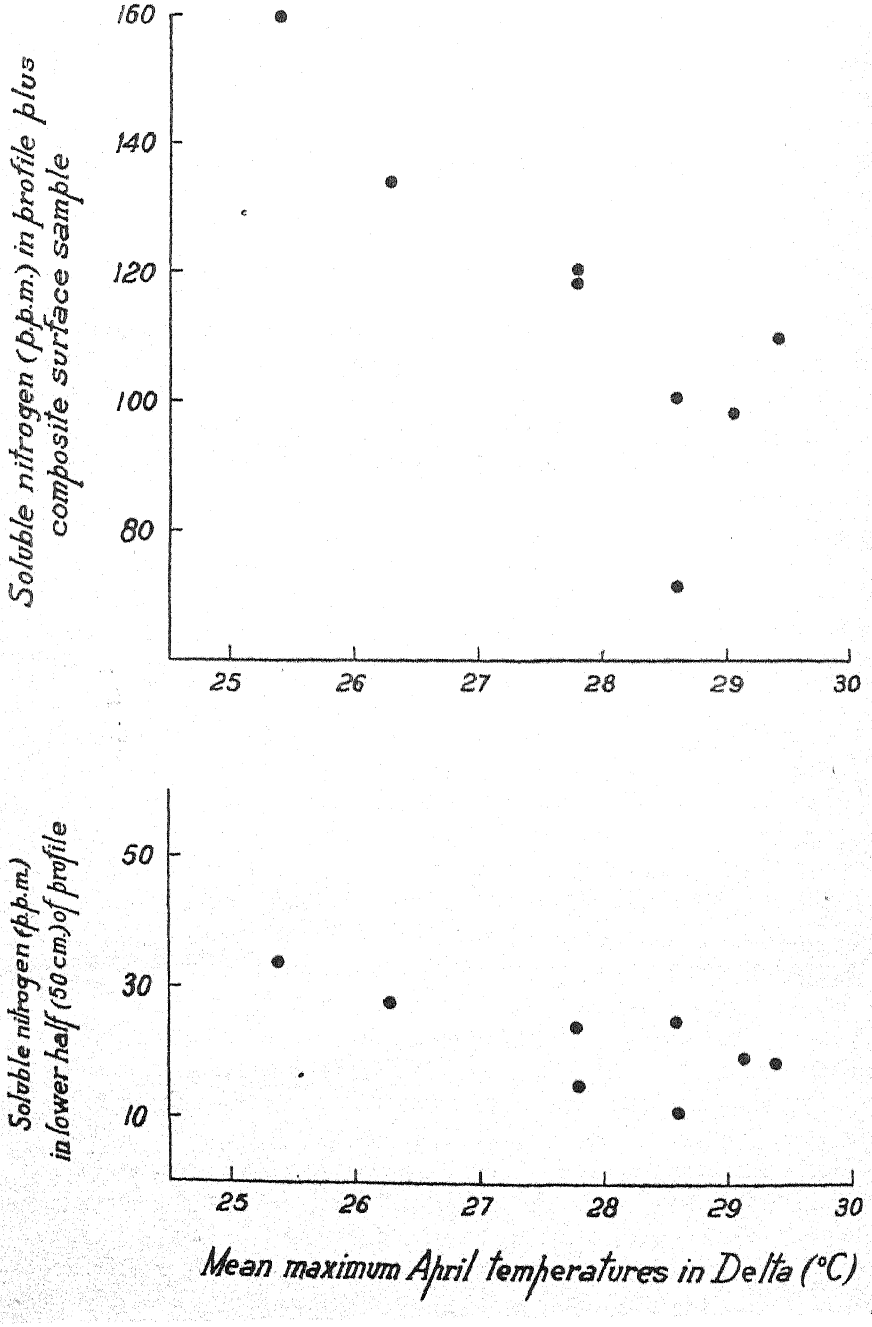
	At Sowing		*At Thinning*								
Year	1938	1939	1938	1939	1940	1941	1942	1943	1944	1945	1946
Mean max. temp., °C. March	21·5	23·9	—	—	24·1	23·8	24·1	21·7	24·7	20·8	23·7
Mean max. temp., °C. April	27·8	28·6	—	—	28·6	29·1	29·8	25·4	29·4	26·3	27·8
Soluble nitrogen ..	55·1	53·8	119·3	71·5	101·1	98·8	169·0	159·6	110·0	134·2	120·3
Hydrolysable nitrogen	67·5	68·4	74·1	71·1	66·0	53·1	} {	59·4	69·6	68·4	69·9

The average content of available nitrogen at sowing was roughly the same in the two years, but became very dissimilar a month and a half later. The soils in the 1938 experiments after the colder spring contained very much larger amounts of soluble (ammoniacal and nitrate) nitrogen than in 1939, all layers of the profiles being affected. The general dependence of the amounts of soluble nitrogen at thinning on what the temperatures have been earlier is shown in Fig. 10, where the average parts per million contained in the profile plus composite surface sample in each year are plotted against the mean maximum April temperatures; much less soluble nitrogen is present after warm springs than after cold ones, and all layers of the profiles are affected. As distinct from the positive effect in individual experiments there is no particular relation between these average values for soluble nitrogen and average control plot yield.

The meaning of a given amount of soluble nitrogen for control plot yield will therefore vary according to season; it is illustrated in Fig. 9 from the 1939 and 1945 experiments. Not only is the soluble nitrogen higher on the average after the cold spring of 1945 than the warm one of 1939, but the range of values encountered is very much greater. In calculating relationships between nitrogen and yield the more extreme of these values have been dropped. The two so dropped in 1945 can be seen from the figure to contain over 360 parts per million "soluble" nitrogen in the profile plus composite surface sample; but even these large amounts have been exceeded in thirteen experiments in other years, six of them being in 1943, when the month of April was coldest. Such large amounts of soluble nitrogen are very much greater than can be utilized by the crop, so that, in spite of their more frequent occurrence in the colder seasons when the uptake of nitrogen will have been less, they raise the question as to what category of nitrogen, in addition to

Fig. 10

RELATIONSHIP BETWEEN APRIL TEMPERATURES AND SOLUBLE NITROGEN AT THINNING



nitrate, is being extracted by the salt solutions used in their estimation. In the fifteen experiments containing these very large amounts of soluble nitrogen the increase from fertilizer nitrogen varied up to 6 kantars and averaged 2·25 kantars per feddan.

Regarding the experiments as a whole, the result was seriously influenced by deficiency in available soil nitrogen only in the two years 1939 and 1941, when the average amounts of soluble nitrogen were lowest. In these two years low-yielding land gave the best response in Lower as well as Upper Egypt—they are the only years in which the soluble nitrogen can be directly related to maximum increase.* In 1939, when the average soluble nitrogen was least, the hydrolysable nitrogen fraction assumed its greatest importance.

The separation of the results for Upper and Lower Egypt does not add to the information given, but a very useful subdivision which can be made is that for the experiments conducted after rice. The average amount of available nitrogen, eliminating seasonal effect, in twenty-seven of these carried out in seven years is compared below with a similar average for all experiments:

AVERAGE (ELIMINATING SEASON) AVAILABLE NITROGEN IN EXPERIMENTS AFTER RICE AS COMPARED WITH ALL EXPERIMENTS

	Experiments after Rice		*All Experiments*	
	Soluble Nitrogen	*Hydrolysable Nitrogen*	*Soluble Nitrogen*	*Hydrolysable Nitrogen*
Totals in profile plus composite surface sample	89·8	67·3	114·2	66·2

The greater degree of response of cotton after rice as compared with other crops is therefore associated with a lower available nitrogen in the soil; the difference occurs in the soluble nitrogen fraction, and the subsoil layers are proportionately more affected.

There is a continuous variation in the state of the organic matter and nitrogen present which is best illustrated by the experiments† on "sharaqi" (fallow) land. The effect of a period of bare fallow, or drying, is to increase the amount of soluble (ammoniacal and nitrate) nitrogen, and the experiments on sharaqi land show that if bacterial activity (by irrigation) is reintroduced too soon before the planting of the succeeding crop, a considerable part of the benefit is lost. One experiment with cotton on land fairly well supplied with nitrogen showed that a watering before ploughing given about a month before sowing caused a reduction in the available nitrogen amounting to rather more than one sack* of fertilizer per feddan, as compared with land ploughed dry. The " loss " is not a permanent one; it occurs through some of the soluble nitrogen being converted by bacterial action to more unavailable forms which will only slowly again become available. The lowered soluble nitrogen in the soils of the experiments after rice may similarly be the result of their treatment in the previous summer.

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* As already mentioned, deficiency in available soil nitrogen in the two years may not have been the only factor; the month of May was warmest in 1939 and 1941 and the exceptional heat may have interfered with the normal development of forward plants.

† The experiments on sharaqi land are reported in full in "The Quantity Distribution and Composition of the Organic Matter and Available Nitrogen in Egyptian Soils," by D. S. Gracie and F. Khalil, *Technical Bull. No.* 222, Ministry of Agriculture, Egypt (1939).

These observations provide the background against which the question of time of application of nitrogenous fertilizers should be considered. Their addition at the time of sowing results in a serious loss of efficiency similar to what happens to the soluble nitrogen in sharaqi land if it is watered too soon before the planting of the succeeding crop. It might, however, be good practice to give part of any nitrogenous fertilizer dressing at the watering before the thinning watering, in cases where the soluble nitrogen can be expected to be below the average, as with the experiments after rice. Where the deficiency arises as the result of a warm spring it is more difficult to advise it, since one is then more in the position of being wiser after the event.

This treatment of the available soil nitrogen leaves untouched the question as to how far the dependence of control plot yield on the soluble nitrogen is purely a nitrogen effect, or is in addition the reflection of more deep-seated changes (deterioration) whereof a reduced organic matter status may be one of the symptoms.†

EFFECT OF SUPERPHOSPHATE

The degree of significant positive response to superphosphate (25·8 per cent.) as well as the average yield effect (0·18 kantar per feddan) are very much less than with nitrogen; the fact that significant depressions can result must also be taken into account.

The subsoils of perennially irrigated land are gradually being reduced to a state of uniform exhaustion in available phosphoric acid, while the supply in the surface layers is being more or less maintained by the additions being made to them; more phosphoric acid on the whole is being removed from the soils than is being returned to them.‡ One consequence of this is that the variability of the surface layers has been increased, while that of the subsoils had substantially declined; another is that the available phosphoric acid in perennial soils now decreases markedly with depth in pronounced distinction to the uniform distribution of basin land. Response to superphosphate with cotton may occur when its amount sinks below a certain minimum value anywhere within the top metre. This may not happen until the bottom layer of the profile is reached, but generally occurs above it and may (exceptionally) begin at the very surface. The surface layers of profiles from experiments giving a significant positive response are poorer in available phosphoric acid than the surface layers of profiles from the Delta where there was no such response; the difference is not so great as between the subsoils, but it is still considerable. With the much greater variability of surface as compared with subsoil it is clear that it would be impossible to determine whether a soil is deficient in available phosphoric acid for cotton merely by an examination of the surface layer, except in the rare cases where that surface layer itself has become deficient. When all subsoils become uniformly exhausted, as they eventually will, this difficulty will no longer obtain.

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* A sack of fertiliser per feddan means 15½ kg N.

† "The Nature of Soil Deterioration in Egypt," by D. S. Gracie, M. Rizk, A. Moukhtar and A. H. I. Moustafa, Ministry of Agriculture, Egypt, Technical and Scientific Service, *Bulletin No.* 148 (1934).

‡ See Ref. No. 6, COTTON GROWING REVIEW, April, p. 100.

INTERACTION OF NITROGEN AND SUPERPHOSPHATE

Taking the experiments *as a whole*, there is no consistent interaction between nitrogen and superphosphate where the direct effect from the latter is small. Where the average effect from superphosphate becomes greater, interaction appears, and means that the efficiency of the larger dressings of nitrogen is increased.

Since the effect of superphosphate in the experiments has been small, interaction with nitrogen has on the whole been negligible; as the subsoils of perennial land become increasingly exhausted of available phosphoric acid and the need for superphosphate increases, the interaction will also become of greater importance.

SUPERPHOSPHATE, TEMPERATURE AND NITROGEN

The influence of temperature on yield returns from superphosphate is inconsiderable, but it is interesting because it acts in a manner directly contrary to what has been shown for nitrogen. The fact that the average effect from superphosphate is greater in cold springs than in warm ones would scarcely be worth mentioning here were it not that it is confirmed by the very strong connection between minimum January and February temperatures and the average response to superphosphate by wheat, and that it may become of greater importance in the future. With average benefit tending to be greater in cold weather, depressant effects, on the other hand, can occur on soils rich in available phosphoric acid, where nitrogen supply and temperature combined favour rapid vegetative growth.

The nature of these depressant effects receives its best illustration from a few exceptional results among the 1938-40 experiments, which included a comparison of the effect of nitrogen and superphosphate used separately and together on dibble-sown cotton as compared with cotton sown in the ordinary way; dibble-sowing* properly carried out results in plants whose growth performance is superior. The rare cases of depression from superphosphate tend to occur in the warmer parts of Egypt where conditions, including nitrogen supply, are very favourable, but where the water available is insufficient to maintain the further growth occasioned when superphosphate is added.

Practical Application

The treatment of the results for practical purposes makes use of the fact that the most fundamental aspect of individual experiments is the series of parallel lines that may result when yields are plotted against treatments for any one variety and year. The experiments have therefore been grouped according to control plot yield regardless of season, but dealing with Upper Egypt separately from the Delta. The total increases in yield over the control plots at each nitrogen level are then averaged for the experiments in each group. The result is illustrated in Fig. 11. In the Delta (Fig. 11B) the efficiency of a given amount of nitrogen rises abruptly to a maximum when control plot yields of 5 kantars are reached, the disparity with yield levels lower than this increasing with the amount of nitrogen given. Efficiency is maintained at the maximum on 6-kantar land and then decreases as the available nitrogen in the soil becomes more adequate, but it remains substantially above that on 4-kantar land until the five experiments (not shown in the diagram) with control plot yields of 9 kantars or more are reached, when it again becomes very low. The response curves of Fig. 11C provide another way of showing the same differences in efficiency; the return from 1 N on land already yielding 5 kantars or more is greater than on lower-yielding land, and the steeper slope of the curve thereafter means that the advantage increases as more nitrogen is given.

The return from a given amount of fertilizer nitrogen in Upper Egypt is always greater on the whole than what is found in the Delta; maximum efficiency is reached at the lower yield level of 4 kantars, but thereafter the efficiency of the two higher dressings falls below even what is obtained on 3-kantar land, and continues to fall. This decrease in efficiency does not apply to the first 100 kilos of fertilizer (15½ kilos nitrogen), the return from which is relatively stable at 1 kantar or more for all control plot groups except the one at 7 kantars.

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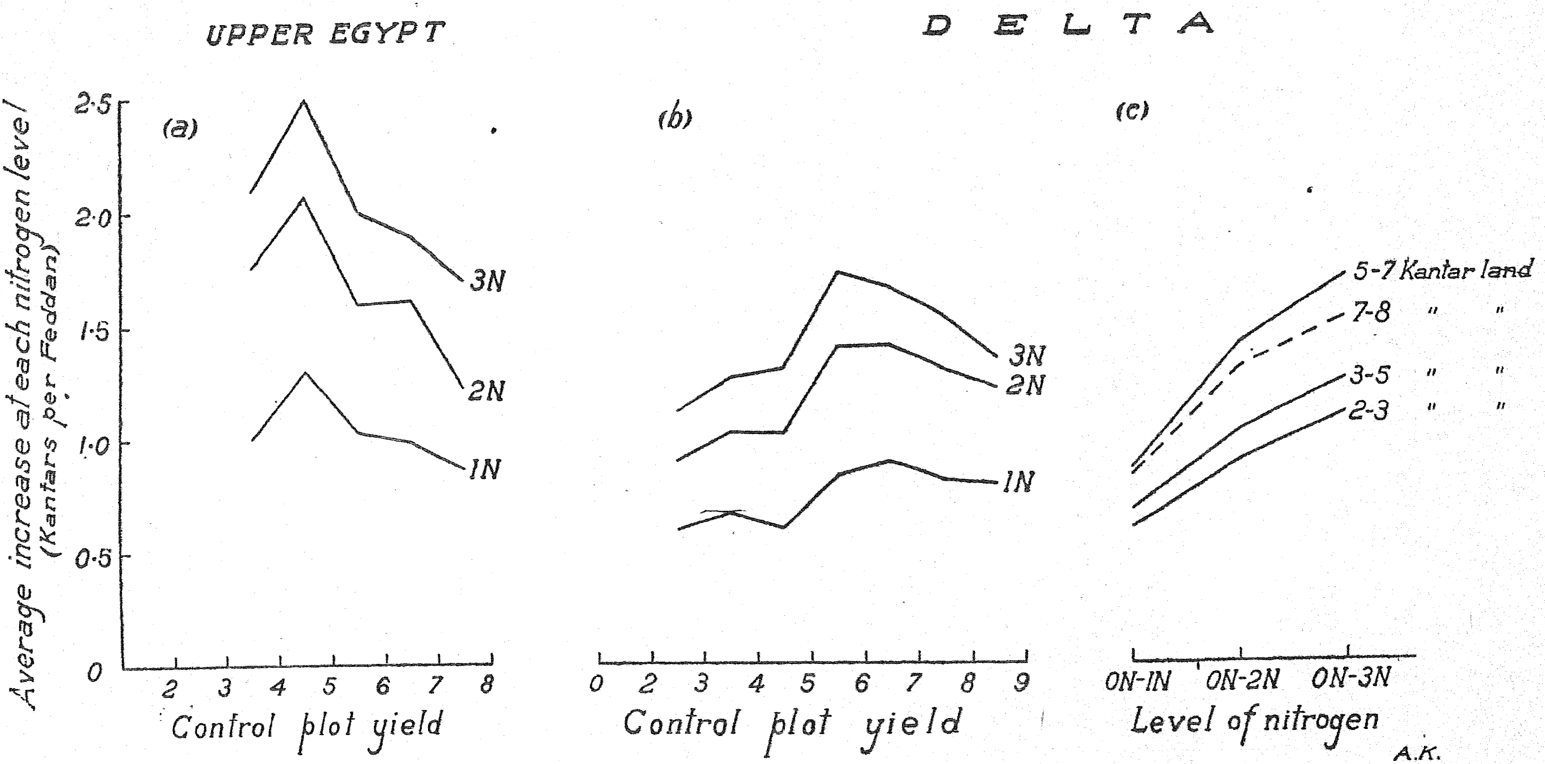
* See Ref. No. 5, p. 100.

Fig. 11

RELATIONSHIP BETWEEN LEVEL OF YIELD AND RESPONSE TO NITROGEN



Level of Yield, and the Factors which Determine It

This variation in the efficiency of added nitrogen with size of control plot yield is an accessory feature; it is the figures for average total production in each control plot group that are fundamental in both regions. They show that it is the control plot yield that dominates the situation; once it is fixed no amount of manure can in general alter it and convert, for example, a 4-kantar crop to one of 5 kantars or one of 8 kantars to one of 9. Nitrogen, whether already available in the soil or given as fertilizer, can in general only act within the limits imposed by the factors determining the level of yield. If in the Delta these can be adjusted to give a control plot yield of 5 kantars or more, then increased efficiency of fertilizer nitrogen follows as a matter of course, but the actual level to which they have been adjusted continues to dominate the result.

The factors which determine the level of yield are the physical properties of the soil in conjunction with irrigation practice, spacing, locality and sowing date, all in interaction with the nature of the season; variety can be regarded as an expression of locality. The immediate interest here is in sowing date, locality and the previous crop. Maintaining the control plot grouping of Fig. 11, the analysis has therefore been extended by splitting up the Delta experiments according to whether they come after bersim, after rice, or after other crops (chiefly maize), and the experiments in the last category divided again into those respectively north and south of latitude 31° 00′ (*i.e.*, of a line passing roughly through Damanhour and Mansoura). For each of these four subdivisions the average sowing date, and its range, and the average total increases from nitrogen have been taken out for the experiments in the different control plot groups. The experiments in Upper Egypt can be usefully subdivided only according to whether they are after bersim or after maize and other crops.

Average Response to Nitrogen according to Level of Yield as determined by Locality, Sowing Date and the Previous Crop

(Kantars per feddan)

Control Plot Yields lying between—	*Number of Experiments*	*Average Total Increases over Control Plot Yields in moving from—*			*Average Sowing Date (March)*	*Range of Sowing Date*
		O-1N	O-2N	O-3N		
Delta experiments north of latitude 31° 00′ (mainly after maize)						
2-3	3	0·64	0·82	0·84	18	7/3- 2/4
3-4	11	0·55	0·86	0·90	17	7/3-23/3
4-5	12	0·29	0·65	0·79	13	28/2-24/3
5-6	12	0·74	1·07	1·39	16	7/3-24/3
6-7	6	0·83	1·43	1·76	8	25/2-19/3
7-8	9	0·74	1·01	1·32	12	27/2-27/3
8-9	1	1·56	2·89	3·11	18	—

Control Plot Yields lying between—	*Number of Experiments*	*Average Total Increases over Control Plot Yields in moving from—*			*Average Sowing Date (March)*	*Range of Sowing Date*
		O-1N	O-2N	O-3N		
Delta experiments south of latitude 31° 00′ (mainly after maize)						
2-3	3	0·80	1·43	2·08	15	—
3-4	7	0·89	1·41	1·72	9	26·2-22/3
4-5	23	0·57	0·89	1·09	9	22/2-18/3
5-6	42	0·87	1·49	1·83	6	15/2-26/3
6-7	29	0·94	1·40	1·66	3	21/2-27/3
7-8	21	1·08	1·63	1·93	2	19/2-21/3
8-9	9	0·91	1·19	1·32	2	19/2-11/3
9-10	1	—0·15	+0·39	—0·10	4	—
10-11	2	0·92	0·96	0·75	5	—
For Delta experiments after bersim						
1-2	2	0·42	0·71	0·92	26	—
2-3	1	—	—	—	—	—
3-4	9	0·63	1·07	1·32	14	29/2-28/3
4-5	20	0·68	1·11	1·40	22	5/3- 3/4
5-6	14	0·74	1·18	1·51	12	2/3-31/3
6-7	10	0·76	1·21	1·53	12	28/2-28/3
7-8	10	0·59	1·15	1·41	10	1/3-20/3
8-9	4	0·32	0·82	0·83	10	3/3-21/3
9-10	1	0·02	0·34	0·14	Feb.24	—
10+	1	0·70	0·92	0·98	5	—
For Delta experiments after rice						
2-3	7	0·48	0·70	0·74	18	—
3-4	10	0·69	0·92	1·19	13	—
4-5	18	0·79	1·34	1·72	14	—
5-6	12	0·87	1·54	1·93	15	—
6-7	4	0·90	1·70	1·80	17	—
7-8	3	0·15	0·24	—	5	—
8-9	1	0·94	1·37	1·64	23	—
For experiments in Upper Egypt (mainly after maize)						
3-4	22	1·05	1·81	2·17	5	11/2-28/3
4-5	23	1·13	1·91	2·28	1	17/2-11/3
5-6	26	1·18	1·61	2·01	1	15/2-20/3
6-7	25	1·11	1·74	2·07	3	13/2-22/3
7-8	17	0·84	1·24	1·71	3	15/2-19/4
8-9	11	1·00	1·46	1·84	1	17/2-17/3
9-10	9	1·21	1·27	1·32	1	22/2-12/3
10+	3	1·13	1·69	1·78	Feb.23	—
For experiments in Upper Egypt after bersim						
3-4	1	0·56	0·87	0·86	30	—
4-5	9	1·69	2·34	3·01	11	26/2- 4/4
5-6	6	0·56	1·49	1·85	9	2/3-18/3
6-7	6	0·58	1·14	1·17	12	26/2-27/3
7-8	6	0·96	1·20	1·63	10	23/2-29/3
8-9	0	—	—	—	—	—
9-10	1	0·40	1·44	1·73	27	—
10+	1	0·98	2·19	2·65	Feb.20	—

Influence of Sowing Date

The influence of sowing date in the Delta is very clear. South of 31° 00′, where early sowings are more generally possible, three-quarters of the experiments have control plot yields of 5 kantars or more; for the later sown experiments in the north and after bersim the number at these higher levels decreases to roughly one-half of the total, while these levels constitute a third only of the still later sown experiments after rice, although it must be remembered that the lowered available nitrogen in the soils after rice contributes to this result. In the same way within each series of experiments, with the exception of those after rice, progressive increase in level of yield goes hand in hand with increased earliness in sowing, but most markedly in the southern region, where really early sowing is more often possible, and the proportion of high-yielding experiments consequently greatest.

The early average sowing dates of the more favourable growing seasons of Upper Egypt show no such general association with the yield levels (just as the control plot yields in individual experiments are indifferent to the dates on which they were sown), although it is notable that the highest yields are the result of February sowings. As in the Delta the average sowing dates after bersim are again consistently later than after maize.

The later average sowing dates in the experiments after bersim are not due to exceptional lateness in a few, but are the result of a real shift in time of the whole body of experiments conducted after that crop, similar to what happens in moving from Upper Egypt to Lower or from the southern to the northern half of the Delta.

Efficiency of Nitrogen in Relation to Locality Level of Yield, Sowing Date and the Previous Crop

The pattern of response shown in Fig. 11B and C is repeated in all subdivisions of the Delta experiments, with the efficiency of fertilizer nitrogen rising to a maximum when control plot yields of 5 kantars or more are reached. The actual amount of benefit at any given level is at the same time always less in the north than in the south, in agreement with the later average sowing dates of the cooler region. This is the "normal" expectation in the Delta already demonstrated from individual experiments—namely, that both yield without manure and increase from its use depend on earliness in sowing, so that they increase and decrease together, but that the amount of benefit possible is determined by the actual temperatures experienced as well as by the extent to which advantage is taken of them, by sowing early.

The Delta experiments after bersim are well distributed throughout the area, but the degree of response is in accordance with their average sowing dates and is therefore similar to that found in the north, except for the greater efficiency of nitrogen at the 3- and 4-kantar levels. The experiments after rice, on the other hand, are mainly in the north and therefore late sown, and the fact that the efficiency of added nitrogen in them is if anything higher even than that found in the south is the result of the unusually low soluble nitrogen present at thinning. The abnormally high return from nitrogen at the two lowest control plot groups in the experiments south of latitude 31° 00′ is also to be attributed to deficiency in available soil nitrogen.

The late sowing of the experiments after bersim in Upper Egypt has again resulted in a diminished return from nitrogen with the outstanding exception of the nine at the 4-kantar level, where the average benefit is higher than for any other group. The separation of the experiments after bersim from the main body considerably modifies the picture for Upper Egypt shown in Fig. 11A; in 70 per cent. of the experiments after maize 2 kantars or more are then obtained from 3N and the average return from 1N is never less than 1 kantar except with the control plot group at 7 kantars.

Seasonal Variation in General

From the locality or climatic point of view one can move in the cotton-growing area of Egypt from the south, where no one would willingly grow the crop without an adequate supply of nitrogenous fertilizer, to low-yielding land in the north where its use is inadvisable. It is equally important to realize the implications of long-term alterations in climate, similar to the geographical alterations encountered in moving between north and south in the cotton-growing area. Such a long-period change took place during the thirty-five years from 1904 to 1940, and means that our experiments were conducted during a period of high or rising temperature. Prior to 1914 the opinion was expressed that the nitrogenous manuring of cotton in the Delta did not pay,* which was certainly not the case in most of the years during which the experiments have been running. The difference between the low March temperatures when that opinion was formed and those which happened regularly in 1931-40 is very striking. The conclusions to be drawn from it would be quite definite were it not for the measures introduced after 1912 to minimize the effect of the pink bollworm. These included changes in methods of cultivation such as closer spacing and the growing of higher-yielding varieties. This necessity for an earlier crop may have created a permanent need for additional nitrogen (of which there is no measure), apart altogether from any temperature change. With

* F. Hughes, *Year Book of the Khedivial Agricultural Society*, p. 159 (1909). J. A. Prescott, *Bulletin No.* 13 of the Sultanic Agricultural Society, p. 47 (1924).

this reservation it is evident that the sixteen years during which the effect of nitrogen has been investigated form part of a period when temperatures happened to be such as to favour benefit from its use. When temperatures fall again opinion as to its utility will equally undergo revision. Long-term seasonal variation of this kind naturally affects cotton in the Delta much more than in Upper Egypt where, with a warmer climate, nitrogenous manuring will always be useful.

Conclusions

It follows from the foregoing that the only practical steps that can be taken (regarding the country as a whole) to increase the efficiency of nitrogenous fertilizers must be directed towards raising the general yield level to the extent permitted by locality and season. Unfavourable seasons cannot be avoided, but a great deal can still be done to mitigate their effects. The main concern must always be to increase the number of early bolls; yield effects from late bolls are limited and uncertain.

The maximum production recorded is in Upper Egypt, where 13 kantars per feddan have been obtained in four experiments and where yields of 10 kantars or more have been common. Such high yields as these last are not so frequently possible in Lower Egypt; the maximum there is represented by the 12 kantars obtained in one experiment in 1944, and there are only seven experiments in which the yield has been more than 11 kantars. These desirable yields include the effect of added nitrogen, but they are essentially an end result of the suitable adjustment of such factors as irrigation practice and spacing, combined with early sowing on good soils in favourable seasons.

In the period covered by the experiments there has been a movement towards closer spacing, but the country as a whole has not gone far enough in that direction, or at least had not done so by 1940, when the last spacing census was made. It possibly never will, since impracticably close ridging would be necessary to secure it, but the special necessity for closest spacing in cold springs should not be forgotten. The position as regards irrigation practice is very similar. The time scale of the early waterings has on the average always been—variably and perhaps to some extent unavoidably—below the optimum, and its importance received its best illustration in the low temperatures of the 1938 growing season, when it was decisive for yield effects in dibble-sowing.*

The limits to earliness in sowing (Fig. 7) are clearly set by locality and season and, while the highest yields cannot be obtained without it, too early sowing in an unsuitable season can result in serious loss, if only from the amount of resowing it entails. The penalty that must equally be paid if cotton is late sown is well brought out by the inferior average result obtained after catch-crop bersim. The highest yields can be obtained after bersim if the cotton is sown reasonably early, and the problem with late sowing after bersim is quite simply whether the value of the fodder gained offsets the loss of cotton that is certain to be incurred. A comparison of the sowing-date ranges in these experiments after bersim with those in the experiments after maize shows that while the upper limits are distinctly later the lower limits are the same. This means that there is room for improvement in the adjustment of sowing date with all groups of experiments. Assistance in this could be obtained from dibble-sowing, since the amount of resowing necessary is always significantly less where the method has been properly carried out. The difficulty with it is the extra labour involved, but it has been suggested that this could be largely overcome by delinting the seed and using a semi-automatic dibble.* It should be clearly understood at the same time that the use of the method will not alter the optimum sowing date.

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* See Ref. No. 5, p. 100.

The comparison in Figs. 1A and 1B of the average yields in the experiments with the averages for the whole country shows that the experiments run at a much higher level. To the extent that this is due to the experiments being carried out on land better than the average it would necessitate a scaling down of the level of yield. This would in turn involve a scaling down of the benefit, in so far as the Delta is concerned, but would not affect the estimate of the return from nitrogen in Upper Egypt, which might even be slightly increased, since it is at a maximum on 4-kantar land. In a recent appraisement† of the statistics for agricultural yield in the country it was calculated that the cotton area in Upper Egypt must have been receiving nitrogenous fertilizer at the rate of 3N (the equivalent of 2 kantars in the average yield) at least as early as 1935 and may subsequently have been getting rather more; the rate of application to Delta cotton is more uncertain, but it had reached an average of at least 1N (15½ kilos of nitrogen) by 1935. The uncertainty about the amount going to Delta cotton arises partly because the total amount is very far from being evenly distributed. The use of artificial nitrogen would begin in the south, where the largest return is obtained from it, and gradually spread northwards; low-yielding land in the north is very unlikely ever to have received very much.

From the seasonal point of view the most disconcerting swings in yield occur on the inferior or deteriorated soils. Such soils are of more frequent occurrence in the north, where the expectation from fertilizer nitrogen for climatic reasons even on normal soils is in any case least. The problem of increasing the efficiency of fertilizer nitrogen in the Delta is therefore bound up with the general question of the prevention and remedying of soil deterioration. It follows that careful attention to proper adjustment of the other factors determining yield level (such as irrigation practice, spacing, sowing date and method) is of special importance for success on deteriorated soils (as it is in unfavourable seasons), while in the perverse nature of things such soils are least likely to receive it.

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* See Ref. No. 5, p. 100.

† "Evaluating the Effect of Nitrogenous Fertilisers by Combining Statistical and Agronomic Data," by W. L. Balls, D. S. Gracie and K. Khalil, *Tech. Bull. No.* 249, Ministry of Agriculture, Egypt (1948).

Received November, 1949.

DEVELOPMENTS IN THE WORLD RAW COTTON SITUATION DURING THE 1948-49 SEASON

BY

DUDLEY WINDEL

FINAL figures of world production of commercial cotton this season are not yet available as the Southern Hemisphere crops are only now being harvested, but on the basis of the latest statistical estimates the 1949-50 world crop will be around 30,500,000 bales, or approximately 2,300,000 bales more than the 1948-49 outturn. Production has shown a steady expansion since the termination of the last world war and is now close to the average of the immediate pre-war years.

SUPPLY AND DISTRIBUTION OF ALL COMMERCIAL COTTON IN THE WORLD*

AMERICAN IN RUNNING BALES; OTHER GROWTHS IN EQUIVALENT 478 LB. NET BALES (000'S OMITTED)

Season	*Carryover August 1*	*Production*	*Total Supply*	*Consumption*	*Destroyed*	*Carryover July 31*
1936-37 ..	13,649	30,729	44,378	30,638	45	13,695
1937-38 ..	13,695	36,745	50,440	27,573	165	22,702
1938-39 ..	22,702	27,509	50,211	28,507	66	21,638
1939-40 ..	21,638	27,326	48,964	28,496	206	20,262
1940-41 ..	20,262	28,720	48,982	26,595	220	22,167
1941-42 ..	22,167	25,616	47,783	25,033	165	22,585
1942-43 ..	22,585	25,582	48,167	24,293	304	23,570
1943-44 ..	23,570	24,521	48,091	22,566	121	25,404
1944-45 ..	25,404	23,631	49,035	22,204	233	26,598
1945-46 ..	26,598	19,890	46,488	23,110	337	23,041
1946-47 ..	23,041	20,279	43,320	25,893	205	17,222
1947-48 ..	17,546	23,489	41,035	26,975	230	13,830
1948-49 ..	13,830	27,222	41,052	26,147	250	14,655
1949-50 ..	14,655	30,500	45,155	27,720	250	17,185

The United States is the principal contributor to the increase in world production this season, having harvested a crop of almost 16,000,000 bales, as against 14,650,000 bales last season. Mexico takes second place with a record yield of 985,000 bales—415,000 bales more than in 1948-49. Larger crops were also gathered in India, Pakistan, Russia, Argentina and Turkey. Chinese cotton production suffered as a result of the hostilities, but the quantity delivered to the mills for commercial use was larger than in the previous season as a result of the restoration of internal communications. The only important cotton-growing country which failed to grow as much cotton as in 1948-49 was Uganda, where unfavourable weather adversely affected yields.

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* Source: New York Cotton Exchange to 1946-47. Writer's estimates 1947-48 to 1949-50.

Both Egypt and Brazil planted larger acreages to cotton than last season, but heavy leafworm damage in the former and excessive rains in the latter so reduced the average yield per acre that their respective harvests appear only about the same size as in 1948-49.

WORLD CARRYOVER AND PRODUCTION OF COMMERCIAL COTTON IN THE WORLD

AMERICAN IN RUNNING BALES; FOREIGN IN EQUIVALENT 478 LB. NET BALES (000's OMITTED)

World Stocks, July 31, 1949.	
U.S.A.	5,300
Canada	55
Mexico	130
Other N. America	20
Brazil	850
Argentina	410
Peru	120
Other S. America	110
U.K.	1,580
France	310
Italy	355
Russia	750
Germany (all Zones)	150
Holland	65
Belgium	85
Sweden	70
Spain	75
Czechoslovakia	70
Poland	120
Other Continent	260
India	1,100
Pakistan	70
China	600
Japan	395
Turkey	90
Other Asia	110
Egypt	650
Belgian Congo	85
Other Africa	320
Australia, etc.	50
Afloat	300
	14,655

*World Production, 1949-50.**	
U.S.A.	16,000
Mexico	985
Other N. America	50
Brazil	1,550
Argentina	575
Peru	320
Other S. America	110
Europe	195
Russia	2,700
Turkey	445
Persia	95
India	2,300
Pakistan	950
China	1,000
Burma	20
Other Asia	200
Egypt	1,800
Belgian Congo	220
British East Africa	320
Nigeria	50
French Africa	155
Portuguese Africa	140
Sudan	260
Other Africa	30
Elsewhere	30
	30,500

Adding the 1949 carryover to the indicated 1949-50 world production gives a total available supply for the season of 45,155,000 bales, which compares with 41,052,000 bales last season. Of this season's total, United States cotton accounts for 21,300,000 bales, or about 47 per cent.

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* Preliminary.

Fuller details of the crops in the various cotton-producing countries are summarized below:

NORTH AMERICA

United States.—Acreage planted to cotton last year was 27,719,000 acres, an increase of 20 per cent. on the 1948 area of 23,110,000 acres. The growing season was very favourable in Texas and in the irrigated districts of California, Arizona and New Mexico, but cool showery weather resulted in a good deal of weevil damage to the crop in the Central and Eastern States. The average yield per acre at 283·9 lb. compared with 312·6 lb. in 1948-49, which was an all-time record.

The total harvest amounted to 15,905,000 running bales, as against 14,580,000 bales in the previous season.

Mexico.—The 1949 area under cotton cultivation was increased 40 per cent. to approximately 1,500,000 acres. The growing period was exceptionally favourable and resulted in an all-time record production of 985,000 bales.

SOUTH AMERICA

Brazil.—The acreage sown to cotton in the Northern States last year was not materially changed from the 1948 figure. The crop enjoyed good weather conditions and averaged above normal in grade. Production is estimated at around 440,000 bales (equiv. 478 lb.).

Acreage planted to cotton in South Brazil last autumn was about a third larger than a year previous. Prospects were good up to harvesting time, when persistent rains damaged the crop both in quantity and quality. Doubts are now expressed if the final yield will reach last season's outturn of 1,050,000 bales (equiv. 478 lb.).

Peru.—Lack of water in Piura valley reduced cotton plantings for the 1949-50 season by about 20 per cent., compared with the 1948-49 area. Climatic conditions in the other valleys, however, were favourable to the crop. Production of Tanguis is expected to equal last season's figure of 240,000 bales (478 lb.), but only a small Pima crop is in prospect owing to the water deficiency.

Argentina.—The 1949 planted acreage is estimated at around 10 per cent. larger than the 1948 area. The crop made excellent progress up to the commencement of the harvest, when heavy rains, coupled with an acute shortage of pickers, resulted in a considerable deterioration in the grade of the cotton gathered. A high average yield was nevertheless obtained and unofficial quarters place the production at 575,000 bales (equiv. 478 lb.)—a record for Argentina.

Paraguay.—The area under cotton this season is reported to be slightly less than in 1948-49. Weather was normally favourable until harvesting time, when excessive rains lowered the quality of cotton open in the fields. A crop of around 60,000 bales (478 lb.) is generally anticipated, or 10,000 bales more than last season.

AFRICA

Egypt.—The 1949 acreage sown to cotton was around 1,560,000 acres, or 17 per cent. larger than the 1948 plantings. The growing period in Upper Egypt was normally satisfactory, but in lower Egypt the summer was too cool and the crop in many districts was badly damaged by severe leafworm attacks. The final yield is estimated slightly below the 1948 outturn of 1,836,000 bales (equiv. 478 lb.).

Anglo-Egyptian Sudan.—Plantings for the 1949-50 season were about 7 per cent. larger than the figure for the previous season. Growing conditions were very good and resulted in a moderately larger crop of around 260,000 bales (equiv. 478 lb.) in which high grades predominated.

British East Africa.—There was only a slight increase in 1949-50 cotton plantings in Uganda. Weather was much less favourable than in the previous year and yields were comparatively disappointing. Production is estimated at only 275,000 bales (equiv. 478 lb.), as against 330,000 bales in 1948-49. In Tanganyika, however, climatic conditions were much better and the harvest is expected to reach 43,000 bales (equiv. 478 lb.), or 5,000 more than last season's figure.

Belgian Congo.—Acreage under cotton for the 1949-50 season was little changed. Crops benefited from a good growing season and production is estimated at between 190,000 and 210,000 bales (equiv. 478 lb.).

Nigeria.—There was some increase in 1949-50 cotton plantings following the higher prices offered to native growers for their seed-cotton. The exportable surplus is estimated at around 50,000 bales (equiv. 478 lb.).

French Equatorial Africa.—Cotton production for commercial use this season is expected to reach 120,000 bales (equiv. 478 lb.), or 10 per cent. more than in 1948-49.

Portuguese Colonial Africa.—The 1949-50 season was more favourable to the cotton crops in both Angola and Mozambique and production is provisionally placed at 155,000 bales (equiv. 478 lb.).

EUROPE

Continent.—Cotton production in the aggregate at 195,000 bales (equiv. 478 lb.) was little changed in 1949-50 compared with the previous season, increases in the Balkan countries about balancing decreases in Italy and Spain.

ASIA

Russia.—Acreage planted to cotton in 1949 is unofficially reported as 10 per cent. larger than the 1948 area. Average yields, however, are believed to have been lower, so that the estimated harvest of 2,700,000 bales showed only a slight increase on the quantity gathered in the previous season.

Turkey.—Acreage under cotton in Turkey has shown a remarkable expansion since the termination of the last war. The 1949 production at 445,000 bales (equiv. 478 lb.) was almost 50 per cent. higher than the 1948 harvest.

Pakistan.—The 1949-50 cotton acreage is officially estimated at 2,811,000 acres, as against 2,799,000 acres in the previous season. The growing season was generally favourable and production at 950,000 bales (equiv. 478 lb.) was about 50,000 bales larger than the 1948-49 crop.

India.—Acreage under cotton for the 1949-50 season at around 11,500,000 acres was approximately 5 per cent. greater than in 1948-49. The monsoon developed satisfactorily, resulting in an improvement in yields. The commercial crop is estimated at around 2,300,000 bales (equiv. 478 lb.), an increase of about 350,000 bales on the very disappointing outturn for the previous season.

China.—During 1949 the civil war adversely affected cotton growing in North and Central China. An acute shortage of foodstuffs influenced many farmers to plant cereals in place of cotton, and disruption of transport seriously disorganized the marketing of the reduced amount of cotton produced, especially as communications with the Shanghai mills were completely cut off. The 1949-50 crop is unofficially estimated at around 1,700,000 bales (equiv. 478 lb.), a decrease of nearly half a million bales on the 1948-49 production. Of this quantity, however, only about 1,000,000 bales are expected to reach the mills for commercial consumption.

WORLD CONSUMPTION OF RAW COTTON

On the basis of statistical trends during recent months, prospects for world consumption of commercial cotton this season point to a total of around 27,730,000 bales, as against 26,147,000 bales last season. United States consumption promises to be nearly 1,000,000 bales larger, and moderate increases are indicated in the United Kingdom, the European Continent, Russia and Japan. On the other hand, consumption in both India and China is likely to fall behind last season's figures.

Present tentative indications point to a world carryover of raw cotton on July 31, 1950, of 17,175,000 bales, or approximately 2,500,000 bales more than a year previous. Of this prospective increase, about 2,200,000 bales will probably be located in the United States, so that elsewhere in the world the aggregate carryover is likely to be only slightly higher than the July 31, 1949, total. No important changes are indicated in stocks in any of the principal producing or consuming countries.

WORLD CONSUMPTION OF COMMERCIAL COTTON AND PROSPECTIVE CARRYOVER

American in Running Bales; Other Growths in Equivalent 478 lb. Net Bales (000's omitted)

World Consumption, 1949-50.*	
U.S.A.	8,750
Canada	400
Mexico	300
Other North America	75
United Kingdom	2,150
France	1,150
Russia	2,500
Germany (all Zones)	900
Italy	875
Belgium	400
Czechoslovakia	275
Holland	260
Poland	400
Spain	350
Switzerland	120
Portugal	150
Sweden	120
Hungary	140
Austria	90
Other Europe	450
India	3,300
Pakistan	120
Japan	900
China	1,000
Turkey	200
Other Asia	350
Brazil	850
Argentina	425
Peru	70
Other South America	250
Africa, Australia, etc.	400
	27,720

World Stocks, July 31, 1950.*	
U.S.A.	7,500
Canada	80
Mexico	150
Other North America	30
Brazil	900
Argentina	500
Peru	150
Other South America	130
United Kingdom	1,200
France	500
Italy	400
Russia	700
Germany	200
Holland	100
Belgium	120
Switzerland	80
Sweden	60
Spain	80
Czechoslovakia	75
Yugoslavia	30
Poland	130
Other Continent	200
India	1,000
Pakistan	150
China	500
Japan	300
Turkey	100
Other Asia	250
Egypt	700
Belgian Congo	120
Other Africa	350
Australia, etc.	50
Afloat	350
	17,185

Prices

Although world raw cotton reserves have risen to the equivalent of almost eight months' consumption—a supply which may be considered as normal—world prices are remaining very firm at more than four times the pre-war level. This situation is due very largely to the following factors: (1) A very large part of the unmarketed supplies in producing countries is held by the U.S. Government under the 1948-49 loan programmes; (ii) U.S. cotton prices are being artificially maintained by 90 per cent. of parity loans; (iii) the world-wide shortage of dollars greatly restricts the amount of U.S.A. cotton which overseas consuming countries can buy, other than that financed by the Economic Co-operation

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* Tentative estimates.

Administration for European Aid; and (iv) there are no large surpluses of such growths as Brazilian, Egyptian, Pakistan, Indian, etc., which can be purchased with soft currencies or against bilateral trade agreements.

There is clear evidence, however, that the artificially high price of cotton is giving considerable stimulus to an expansion of production of rayon and other synthetic fibres, prices of which are only about two-thirds of the present cost of the natural product. Since 1945, world rayon output has more than doubled and this year will probably approach 3,000,000,000 lb. Expansion is world-wide and there is little doubt that the competitive position of cotton will sooner or later be undermined if abnormally high prices of the natural fibre are maintained by United States domestic political policies.

CONCLUSION

To prevent the accumulation of further surpluses in the United States, the U.S. Government has decided this year compulsorily to restrict the cotton acreage to around 22,000,000 acres—*i.e.*, a reduction of about 25 per cent. on the 1949 area. Under average growing conditions, such an acreage should produce a crop of around 12,000,000 bales, or some 4,000,000 bales less than in the past season.

World production of other growths in 1950-51, on the other hand, should be larger than the 14,500,000 bales (equiv. 478 lb.) estimated to have been grown this season. Increased acreages have been planted in Mexico, Turkey, Egypt and Russia and are planned in both Pakistan and India. The prevailing high prices may also be expected to encourage extended cotton growing in several minor producing countries. Acreages to be sown to cotton in the South American republics next autumn cannot be predicted at this early stage, but there would appear no reason to anticipate any reductions. Assuming average growing conditions, the indicated 1950-51 planted acreage outside the United States should produce an aggregate crop of 16,000,000 bales, or 1,500,000 more than the 1949-50 estimated figure.

Prospects for world production of commercial cotton next season can therefore be very tentatively estimated at around 28,000,000, as against 30,500,000 bales for the present season.

World consumption in 1950-51 is very difficult to estimate, as so much depends on developments in the broad political and economic picture, and on the extent to which cotton is replaced by synthetic fibres. However, on the present prospect a world crop of 28,000,000 bales, if realized, should fully suffice to meet the requirements of the world's mills during the coming season; it is very doubtful if world consumption will expand much above the 27,720,000 bales estimated for the present season, and may conceivably be less.

Received June, 1950.

EMPIRE COTTON CROPS FOR THE YEARS 1939-49

In bales of 400 lb.

The seasons are given as covering two years (*e.g.*, 1938-39) because in the majority of the countries named planting takes place in one calendar year and picking in the next. In a few of these countries, however (*e.g.*, Cyprus and some of the West Indian Islands), the crop is harvested in the same year as that in which it is planted. In such cases the figures should be read as relating to the crop grown and harvested in the *latter* of the two years at the head of the column.

Country	1938-39.	1939-40.	1940-41.	1941-42.	1942-43.	1943-44.	1944-45.	1945-46.	1946-47.	1947-48.	1948-49.	
(1) Anglo-Egyptian Sudan ..	331,104	292,706	319,682	295,107	354,109	222,877	374,296	242,343	282,387	276,925	340,305	(1)
(2) Uganda ..	303,893	296,672	368,898	236,370	112,849	191,870	272,064	228,709	231,678	166,000	391,110	(2)
(3) Kenya ..	9,976	11,622	15,094	12,269	5,453	6,330	5,384	5,015	5,148	4,860	9,714	(3)
(4) Tanganyika ..	64,106	65,314	72,766	51,017	38,309	24,797	40,421	41,028	39,963	53,764	51,308	(4)
(5) Nyasaland ..	5,276	6,526	5,376	14,392	5,552	8,450	8,302	9,050	11,166	12,852	2,269	(5)
(6) N. Rhodesia ..	77	68	78	75	39	20	23	36	4	—	—	(6)
(7) S. Rhodesia ..	82	408	433	1,938	1,464	1,657	1,227	870	434	701	2,093	(7)
(8) Union of South Africa and Swaziland ..	747	2,061	1,857	854	584	664	338	340	1,113	2,709	5,176	(8)
(9) Nigeria* ..	24,057	50,632	73,295	36,119	32,494	24,618	15,803	36,602	34,175	21,735	50,737	(9)
(10) Gold Coast ..	5	6	17	20	30	137	—	168	168	305	300	(10)
(11) Cyprus ..	1,705	1,735	722	1,589	1,661	1,341	2,380	1,900	2,000	1,095	1,868	(11)
(12) Ceylon ..	196	261	452	430	46	107	10	31	40	168	840	(12)
(13) Queensland ..	15,457	10,319	14,296	12,312	8,364	7,366	1,627	2,847	1,906	1,782	634	(13)
(14) West Indies ..	5,636	8,492	9,312	7,450	4,555	4,099	4,525	3,762	2,573	3,963	6,723	(14)
	762,317	746,822	882,278	669,942	565,509	494,333	726,400	572,701	612,755	546,859	863,077	

REVIEWS

East African Agriculture. J. K. Matheson and E. M. Bovill (Editors). (Pp. 322. Geoffrey Cumberlege, Oxford University Press, 1950. Price 25s. net.) The scope of this book is fairly and frankly explained in the preface. The editors recognize that a fully adequate treatment of the subject could only be prepared if works comparable to Dr. Tothill's *Agriculture in Uganda* were available from the Departments of Agriculture of Kenya, Tanganyika Territory and Zanzibar. In the absence of any early prospect of such treatment they have collected a series of chapters by individual contributors each dealing with his special subject.

"Our object has been limited and unambitious. We have not aimed at producing either an authoritative textbook or a manual of instruction. This volume is descriptive rather than instructive. It does not pretend to tell the reader how to grow anything, only how it is grown, which is a different and much simpler matter."

Taken in this sense as a descriptive work the book should have a wide sphere of usefulness, especially in this country. It provides a great deal of reliable information not otherwise available for educational purposes, for business men with an interest in any of the great variety of agricultural products ranging from wheat to cloves and copra, and not least for the politicians who discuss with more fervour than knowledge the prospects of African development. No more instructive book could be recommended to the prospective settler.

The subject matter is far from being confined to crops and produce in any narrow sense. Part I deals with topography, climate and native population, with land tenure, white settlement, native labour and welfare, and soil conservation. Part II, the principal section, deals with European agriculture, both plantation products and farmers' crops and livestock, and includes a balanced account of the Tanganyika Groundnut Scheme. Part III is intended to cover native agriculture. It provides an adequate and instructive summary of the subject, but considering that in point of view of the areas and populations concerned it is and must remain the basis of African life, to which European occupation is but incidental, the brevity of its treatment represents a disproportion which must be regarded as the main defect of the book as a whole. The point is well illustrated by reference to cotton. The description of the industry occupies two pages under African Agriculture in Uganda, and a couple of paragraphs under Tanganyika, with a single photograph which is the worst in the book. With an export value which in 1947 approached £8 millions, cotton receives less prominence than several relatively trivial crops of the Kenya Highlands.

An excellent feature is provided in a series of maps of the distribution of native population, physical features, natural vegetation, temperatures and rainfall.

W. N.

THE AGRICULTURE OF THE CULTIVATION STEPPE. N. V. Rounce, assisted by officers of the Department of Agriculture and of the Empire Cotton Growing Corporation. (Longmans, Green and Co., Cape Town, for the Department of Agriculture, Tanganyika Territory, 1949.) To students of African native agriculture the areas of Tanganyika Territory classed as Cultivation Steppe, comprising parts of the Lake, Western and Central Provinces, have a special interest. Much patient investigation has been given to their problems and possibilities, and the information gained has been carefully and lucidly discussed by Mr. Rounce, Senior Agricultural Officer, in this and previous publications.

The Cultivation Steppe is defined as country of unpronounced topography heavily cultivated and grazed by cattle, with sparse areas of bush. In the area covered by the present description eleven tribes, comprising some two million people, are concerned. The main feature which has enabled this area to develop its special character is its existence as an island of tsetse-free country in which cattle can be kept relatively free from disease. For that reason there is an approach to, and there are possibilities of, a closer and more continuous use of land than in the types of country from which cattle are excluded.

It is interesting to note the reaction of these conditions, and of their local variations, on the character and aptitudes of the tribes concerned. We note, for example, in agricultural commentaries on this area the adoption of a native system of soil nomenclature, based on the usefulness of each category for specific purposes. Practices are by no means uniform from tribe to tribe or district to district, but exhibit considerable adaptability. There are reminders, too, that individuals may exhibit differences which in some cases extend to considerable originality. In fact, the essentials of progress exist, given the right conditions, in the untutored African.

The Director of Agriculture, in a foreword, issues a serious warning. The trends which, as expounded by Vogt and others, threaten world agriculture—overpopulation and reduced fertility—are having their effect in this small closed community: "... It is felt that the application of the principles advocated in these pages is essential if large stretches of the Cultivation Steppe are not to be abandoned within the next decade."

The principles concerned are discussed in general terms and in their application to the specific crops of the area in chapters by Rounce and his collaborators. The traditional African system of restoring fertility by fallow periods has been reduced or has altogether disappeared under local population pressure and must of necessity be replaced by the use of manure. Convincing demonstrations are described of the successful application of farmyard manure in various forms, and ways and means of adapting its use to native practice are discussed. The outstanding success in many areas of the adoption of tied ridges as a means of conserving rainfall, preventing erosion and greatly increasing yields are emphasized.

The chapter on cotton is contributed by Mr. J. E. Peat of the Empire Cotton Growing Corporation. Cotton is the important cash crop of the Lake Province. In the period 1942-46 an average of £250,000 a year was paid out through the markets for cotton, compared with £40,000 for paddy and £27,000 for groundnuts. The ten-year average (1935-44) production of lint was 33,500 bales. In its earlier years cotton was relegated to the land least suitable for food crops; now there is a tendency to the increasing use of better soils, but far too much cotton is still planted on worn-out land indifferently prepared, with poor results which tend to be unfairly blamed on the weather.

In 1940 the new strain MZ. 561 began to replace the " Local " cotton and in 1945 it was planted throughout the province. It is now in process of replacement by UK.46, a mixture of strains with a marked superiority in yield and a better ginning percentage. The present low average yields obtained are capable of being improved greatly by simple methods not beyond the capacity of the ordinary cultivator. The ability of the cotton plant to recover from a period of drought or from early attacks of pests and eventually to give a heavy crop distinguishes it from grains and most other crops and adds greatly to its usefulness in a country of uncertain rainfall.

W. N.

NOTES ON CURRENT LITERATURE

COTTON IN INDIA AND PAKISTAN

252. ALL-INDIA THIRD ESTIMATE OF COTTON CROP, 1949-50. (*Cotton*, M/c., 20/5/50.) The third estimate of the 1949-50 cotton crop issued by the Directorate of Economics and Statistics gives the area under cotton as 10,496,00 acres and the estimated yield as 2,055,000 bales. Trade descriptions of the crop are as follows: Bengals 270,000 bales (747,000 acres); Americans 60,000 bales (260,000 acres); Oomras 569,000 bales (4,012,000 acres); Broach 183,000 bales (717,000 acres); Surti 73,000 bales (284,000 acres); Dholleras 260,000 bales (973,000 acres); Others 640,000 bales (3,473,000 acres).

Increase in acreage has mainly occurred in Bombay, Madhya Pradesh, Madras, Saurashtra and Hyderabad and has been attributed to favourable weather conditions at the sowing time.

A significant increase in yield has been recorded in Bombay (especially Gujarat Division) and Saurashtra due to the generally favourable climatic conditions during the last kharif season. Some increase in out-turn has been reported by Madras and Punjab also.

In spite of rise in acreage, Madhya Pradesh and Hyderabad have not recorded any increase in yield, owing to the unfavourable weather conditions at the time of maturity of the crop.

This estimate covers about 90 per cent. of the area which is likely to be reported at the final estimate stage.

253. SPINNING TEST REPORTS ON INDIAN COTTONS, 1948-49. By D. L. Sen. (*Tech. Circs.*, Nos. 791-794. Ind. Cent. Cott. Comm., 1949.) The circulars contain the grader's report and spinning-test results for Bagalkote Jayawant, 1944-49 seasons; Cambodia Co. 3 (Salem), 1944-49 seasons; Tinnevelly, 1942-49 seasons; Upland Gadag, 1941-49 seasons.

254. PREDICTION OF THE SPINNING VALUE OF COTTONS BELONGING TO DIFFERENT BOTANICAL SPECIES FROM THEIR CHIEF FIBRE PROPERTIES. By H. Navkal and D. L. Sen. (*Tech. Bull. Ser. B.*, No. 41. Ind. Cent. Cott. Comm., 1949.) Whilst it is agreed that the best method of judging the quality of a cotton is by spinning it under certain standard conditions, it is not possible to have recourse to this method when a spinning plant is not accessible or the amount of lint that is available is small. Even under such limitations, however, fibre tests could be carried out and the spinning value estimated if reliable regression equations were worked out. This paper deals with the investigation of the relationship between the spinning value and the fibre characters of Indian cottons classified according to the botanical varieties to which they belong.

The following groups were selected for the purpose: *Gossypium hirsutum*, *G. herbaceum* L. var. *frutescens* (Delile) H & G, *G. arboreum* var. *neglectum forma indica*, and *G. arboreum* var. *neglectum forma bengalensis*. For each of these groups the correlation coefficients have been calculated between the spinning value and the fibre characters considered important for that group; linear regression equations have been worked out and the standard error of the estimate has been given in the case of each equation. The actual spinning values, as well as those calculated according to some of the equations, are given in appendices where the differences between the actual and the calculated spinning values have been entered in separate columns to facilitate comparisons.

255. INDIAN COTTON YARNS: CAUSES OF NEPS. By A. N. Gulati. (*Ind. Text. J.*, **60**, 1949, pp. 65 and 140. From *Summ. Curr. Lit.*, xxx, **5**, 1950, p. 122.) Twenty-one samples of yarn of varied counts from twelve distinct varieties of Indian cottons have been investigated in order to obtain information on neppiness. Neps were removed from yarn wound on black cards and examined in 18 per cent. caustic soda solution under the microscope. The percentage incidence of fibre neps, seed coat fragments and leaf fragments, etc., has been investigated and a chart showing the distribution of these " impurities " is given. Values of " neps per gram " give better indications of quality than " neps per unit length." Fibre neps contain either matted fibres or entangled short and immature fibres—broadly speaking 77 per cent. of neps are formed of fibre. Neppiness due to fibre-neps as indicated by neps per gram or per yarn is highly correlated with the immature component of long fibres (longer than 1 inch). A regression equation based on this correlation is recommended for predicting the neppiness of an un-spun cotton from the Balls Sorter length distributions and maturity percentages. The percentage of neps at various stages of yarn manufacture has also been studied and results are tabulated. The results of this investigation are summarized and ten tables of data and several plates of photomicrographs of nep fibres are reproduced.

256. GAORANI 12—ITS SUITABILITY TO THE ENTIRE *Kharif* COTTON AREA OF HYDERABAD STATE. By D. V. Narayanayya. (*Ind. Cott. Grwg. Rev.*, **3**, 4, 1949, p. 187.) In view of the desirability of establishing a single variety wherever possible throughout a cotton-growing area, a number of trials have been carried out in the *kharif* cotton area of the Hyderabad State over the past six years in order to determine the most suitable cotton for the district.

On the basis of its all-round performance, coupled with its more vigorous habit and wilt resistance, Gaorani 12 is recommended as the one variety for the nine districts of the State in which 82 per cent. of the *kharif* cotton area occurs. This area of 1,500,000 acres will probably be the largest area under one improved variety of cotton in India.

257. MADRAS: ANNUAL REPORTS OF THE AGRICULTURAL RESEARCH STATIONS, 1946-47. See Abstract 271.

258. MYSORE: MECHANIZATION OF AGRICULTURE. See Abstract 354.

259. THE INDIAN CENTRAL COTTON COMMITTEE AND ITS WORK. (*Times of India* Press, Bombay, 1949.) This well-produced and illustrated booklet gives an interesting account of the history and operations of the Indian Central Cotton Committee. Including as it does representatives of growers, agricultural officers, traders, spinners and manufacturers, the Committee has been an invaluable forum for the discussion of many problems affecting cotton and the cotton trade. While the Committee's constitution ensures a broad outlook on all matters falling within its purview, its primary concern is the interest and welfare of the cotton grower.

The aim of the Committee has always been to supplement and not supplant the work of the Agricultural Departments in cotton-growing provinces and Indian States. Though certain lines of demarcation have been laid down regarding the investigations which the Committee considers most appropriate for its grants, the general policy is to give assistance in the directions where it is most needed by means of subsidies to Departments of Agriculture in the various cotton-growing Provinces and States for specific investigations on cotton.

The investigations financed by the Committee include botanical schemes for breeding high-yielding superior types of cotton, entomological schemes for the study of the life history of important cotton pests and measures to control them, mycological schemes for finding ways and means to prevent loss due to fungus diseases, and physiological schemes for the study of crop growth. Grants are also made to the Committee for the extension and marketing of improved varieties of cotton and the maintenance of nuclei of pure seed of approved strains for which, for the time being, there is no seed distribution scheme in operation.

The foremost problems in the near future are, firstly, to produce enough cotton in the country of the types comparable to Pakistan varieties, so that India may become independent of supplies from that country as early as possible, and secondly, to breed extra-long staple varieties suited to Indian conditions so that eventually the country may be able to grow them in adequate quantities to meet internal requirements. The future policy of the Committee is designed to serve this dual need and a scheme for the planned production of cotton is set out which, it is hoped, will relieve India from the need to import Pakistan cotton after three to five years.

260. PAKISTAN: COTTON FORECAST. (*Weekly Pakistan News*, 20/5/50.) The supplementary forecast of the area under cotton crop for the year 1949-50 is 2,807,000 acres (American varieties 2,475,000 acres and Desi varieties 332,000 acres) as against 2,704,000 acres (American varieties, 2,257,000 acres and Desi varieties 447,000 acres) of the previous year, and shows an increase of 3·8 per cent. The increase in respect of American varieties is 9·7 per cent., but there is a decrease in respect of Desi varieties by 25·7 per cent.

The supplementary forecast of the yield of cotton crop is 1,170,000 bales of 400 lb. each (American varieties 1,065,000 bales and Desi varieties 105,000 bales) as against 989,000 bales (American varieties 839,000 bales and Desi varieties 150,000 bales) of the previous year, and shows an increase of 18·3 per cent. The yield under Desi varieties has decreased by 30 per cent., but the production of American varieties has increased by 26·9 per cent.

261. PAKISTAN: CENTRAL COTTON COMMITTEE. (*Cott. and Genl. Econ. Rev.*, 14/4/50.) The annual meeting of the Pakistan Central Cotton Committee concluded with the following recommendations: (i) That a target of 1,500,000 bales be established for production in West Pakistan, to be reached as soon as possible; (ii) that steps be taken to arrest the progressive decline in the quality of the Pakistan crop by enactment of legislation on the lines of the Punjab Cotton Control Act; (iii) that the Government's export policy be approved and its import policy amended so that greater facilities be given to countries which are in a position to purchase fairly large quantities of Pakistan cotton.

262. PAKISTAN: COTTONSEED GRADING. (*Weekly Pakis. News.*, 1/4/50.) The Pakistan Government's marketing organization has now undertaken the scheme of grading cottonseed. Pakistan produces 420,000 tons of cottonseed of which 150,000 tons are available for export.

263. COTTON IN PAKISTAN AND THE INDIAN UNION. By R. P. Dunn. (National Cotton Council of America, Memphis, Tenn., 1949, pp. 147. Price 35 cents.) This report is based on information obtained during the author's visit to the Indian Union and Pakistan in 1948. It describes the status and trends in production, distribution and consumption of cotton, and apart from other general information concerning the industry, gives useful data on acreage and yields, irrigation, soils, pests and cultivation practices. The report is well illustrated and includes many tables and diagrams.

COTTON IN THE EMPIRE

264. BRITISH COTTON GROWING ASSOCIATION. The forty-fifth annual report of the Association to December 31, 1949, states that the production of cotton in the British Empire and the Anglo-Egyptian Sudan in 1949 shows a marked increase on the figures of 1948, the total being approximately 864,000 bales (400 lb.) compared with 553,000 bales in the previous year. Considerably larger crops were marketed in Uganda, the Sudan and Nigeria. In spite of delays in obtaining spares and renewals, the Association's buildings and machinery in Nigeria, Uganda and Nyasaland have been maintained in good condition and in efficient working order. A new ginning plant is reaching completion in Uganda, and the provision of new machinery is in hand for Nigeria.

The report includes a summary of the work carried out by the Association and the status of the cotton crop in Pakistan, the Sudan, Uganda, Kenya, Tanganyika, Nigeria, Nyasaland and the West Indies. It urges the further development of transport facilities in these territories as being of the greatest benefit not only to cotton growing but also to other products and the countries generally. The report concludes with a brief history of the Sudan Plantations Syndicate and the Kassala Cotton Company during their period of operation in the Sudan, given as a tribute to the work they have accomplished.

265. CEYLON: HANDLOOM INDUSTRY. (*Ambassador*, 3, 1950, p. 120.) The handloom industry was started in Ceylon about twelve years ago. In spite of difficulties, much progress has been made, and at the present time there are about 1,200 State-owned and 8,000 privately owned looms in use. These looms produced about 20 million yards of cloth a year; this cloth is one process short of the finished goods that are produced by the power mills, and the Department of Industries, anxious to overcome this deficiency, has recently ordered a calendering machine to be purchased from abroad, so that the necessary finishing may be given to the handloom cloth that is produced from many parts of the island.

The Ceylon Government has also formed a project for starting special cotton farms and for providing spinning facilities for handloom cloth manufacture. Hambantota has been found suitable for this project, and the Government aims at producing 30 million yards of cloth annually from the power mill that is to be built. Rs. 12 million have been earmarked for the whole scheme, and Rs. 1 million are to be spent immediately.

266. CYPRUS: COTTON CROP. (*The Countryman*, 4, 3, 1950, p. 7.) Cotton was cultivated on an area of 18,233 donums in 1949 compared with 15,727 donums in 1948 and a pre-war average of 35,268 donums. Yields of unginned cotton, 808,837 okes, were well above the poor crop of 1948; they were 44·36 okes per donum compared with 29·8 okes per donum in 1948 and a pre-war average of 41·09.

267. INCREASING THE COTTON CROP. By A. S. Pearse. (*The Countryman*, [Cyprus], 3, 12, 1949, p. 4.) The author advises cotton growers in Cyprus to produce one variety only, and recommends Coker 100 as being the most suitable to the existing agricultural conditions. The need for a central seed supply is emphasized, and consistent marketing methods for exported cotton are recommended.

268. THE "WHITE GOLD" OF CYPRUS. By A. S. Pearse. (*The Countryman*, 4, 3, 1950, p. 11.) In this article the author explains why cotton gives such a good return to the producer in Cyprus at the present time. He points out that satisfactory conditions are likely to remain for several years to come and advises growers to double their acreage where possible.

269. AFRICA. CENTRAL AFRICA: INTER-TERRITORIAL CO-OPERATION. (Col. Office Inf. Dept., 30/4/50.) Formation of a Rhodesia-Nyasaland Secretariat and Inter-territorial Conference is recommended by a Committee recently set up, under the Chairmanship of the Southern Rhodesia Minister of Justice, to examine the existing machinery for inter-territorial co-operation in Central Africa. The Committee's recommendations have been accepted by the Governments of the three territories concerned—Southern and Northern Rhodesia and Nyasaland. The Conference—consisting of the Prime Minister of Southern Rhodesia and the Governors of Northern Rhodesia and Nyasaland—would meet at least once a year, and would control the secretariat.

The Committee's report envisages that discussions of matters concerning the three territories should begin on the official level, between technical and professional officers. Then recommendations would go to Ministers in Southern Rhodesia and to their counterparts in Northern Rhodesia and Nyasaland. They would not be binding on the respective Governments, but could be implemented by the territories if so desired.

270. EAST AFRICA HIGH COMMISSION, RESEARCH AND SCIENTIFIC SERVICES. 4th Progress Report, May-Sept., 1948, and 5th Progress Report, Aug.-Dec., 1949. These reports summarize recent developments in the Research and Scientific Services. Most of the sections have been prepared by the Directors concerned, but some have been condensed from fuller reports by Directors. They are intended to be read in conjunction with the annual reports for the organizations or departments for the year 1948, and also with previous progress reports in this series. A comprehensive annual report for the year 1949 is in the course of preparation. The following sections are included in these reports: Agriculture and Forestry, Animal Industry, Tsetse and Trypanosomiasis, Fisheries, Scientific and Industrial Research, Locusts, Health and Medicine, and Insecticides. A new feature of the fifth report is the inclusion of

a section on Makerere College, although the college is not a direct responsibility of the East Africa High Commission.

271. GOLD COAST: AGRICULTURAL DEVELOPMENT SCHEME. (*Crown Colonist*, April, 1950, p. 261.) The report of the panel of experts from the British firm of Sir William Halcrow and Partners, who recently investigated the proposed Volta River Project as part of a development scheme for the entire Volta valley, is expected shortly. Matters investigated by the panel, the members of which included an administrative officer, a geologist, and a soil scientist, were: (1) the building of a dam at Ajena, 70 miles from Accra, to provide water power for the generation of electricity, mainly for the processing of aluminium from local deposits of bauxite; (2) the construction of irrigation systems on the Accra plains and elsewhere for food production; and (3) the construction of a large deep-water harbour at Accra or at Ada for the shipping of aluminium and other exports and imports.

It is estimated that 800,000 kW. of electric power, enough both for the production of aluminium and for lighting in the Colony and Ashanti, would be generated at the station to be built at Ajena. The possibility of damming the Black Volta at Bui, in the Northern Territories, for future development of hydro-electric power was also investigated by the panel.

272. KENYA: COTTON CROP. (Ann. Rep. Brit. Cott. Grwg. Assen., 1950.) The total 1948-49 cotton crop in the Colony was 9,714 bales, about double the size of that harvested in the previous season. It is also the largest crop since the season of 1941-42. In the Nyanza Province, where the biggest portion of the crop is grown, about 33,000 acres were planted compared with 24,000 in the previous season. Production was around 7,000 bales. In the Coast Province there was also an increased cotton acreage yielding approximately 3,000 bales.

273. NIGERIA: CROP PROSPECTS, 1949-50. (*Crown Colonist*, May, 1950, p. 325.) The bad rainfall, which did so much harm to the groundnut crop, favoured the early sowing of cotton. Had the weather remained ideal for late sowing, it is probable that the crop would have broken the existing record. The cotton-buying season ends this month, and it is likely that the crop will yield 60,000 bales of 400 lb. each compared with the 47,742 bales last year.

274. COTTON CROP. (Dept. Agric. Ann. Rept., 1948. Received 1950.) A general report of the 1948 cotton crop in the Northern, Eastern and Western Provinces is given, together with summaries of the work on cotton carried out at the research stations at Ibadan and Zaria. The report also includes a summary of the investigation of damage caused by the pink and red bollworms, and the capsid bug, *Helopeltis sanguineus*, and possible methods of control, undertaken by Mr. Q. A. Geering, the entomologist appointed by the Empire Cotton Growing Corporation.

275. TEXTILE CENTRE. (*Ambassador*, **4**, 1950, p. 134.) A textile training centre is reported to have been opened north of Kano, in Nigeria. The aim of this establishment is to provide courses lasting about four months, in spinning and weaving. During the time that the pupils are taking a course, they will be supported by the Native Administration, at the rate of about £2 a month. When they have completed the course, each pupil will receive an advance, in order to cover the purchase of equipment, so that they may set up in business on their own.

A cotton development team is touring Nigeria, in order to plan methods of distributing seeds, siting buying markets and surveying areas which are considered suitable for the production of cotton.

276. ELECTRICITY SUPPLY. (*Crown Colonist*, April, 1950, p. 261.) Work has been started on the utilization of the third fall on the Kurra river for the Nigerian Electricity Supply Corporation. The plant will have a capacity of 4,000 kW. and should be in operation within three years. Cost of construction and of the equipment to be installed is estimated at £175,000.

277. NYASALAND: COTTON CROP. (Dept. Agric. Rept., February, 1950.) The disposal of the Karonga 1949-50 crop was completed on January 25. The crop was a little over 200 tons; 20 tons short of the estimate. Central Province cotton prospects are poor and in the Southern Province, except at Chikwawa and Lisungwi, where

plantings should be satisfactory, the demand for cotton seed has been much below normal. The lateness of the rains, the heavy work entailed in clearing excessive weed growth and the care of the food gardens are probably the reasons for the poor demand for seed.

278. COTTON CROP. (Dept. of Agric. Rept., March, 1950.) Figures of the Northern Province crop, 1949, are Grade 1, 387,412 lb., and Grade 2, 9,364 lb. After last season's drought, this year has brought a deluge in most areas, and most of the crops have been waterlogged. It is hoped, however, that the cotton crop will be an improvement on last year's figures.

279. STATISTICAL HANDBOOK. (*E. Afr. and Rhod.*, 9/2/50.) A statistical handbook of Nyasaland has been issued by the Central African Statistical Office. It comprises thirty-four pages and contains information which will be of value to all interested in the affairs of the Protectorate, including tables of altitude, temperature, rainfall, crop acreages and production, animal husbandry, imports and exports, revenue and expenditure, railway and motor vehicle statistics, and a wide range of tabulated data regarding the European, African and Asian populations. The price of the handbook is not stated, but it is presumably obtainable from the Government Printer in Zomba and the Central African Statistical Office in Salisbury.

280. SOUTHERN RHODESIA: COTTON RESEARCH AND INDUSTRY BOARD, 13TH ANNUAL REPORT, 1948-49. *Cotton Production:* The 1948 crop was very disappointing. After making a good start in the early part of the season, it suffered badly from bollworm attacks, particularly Sudan bollworm, from January onwards until early in March. By then an attack of American bollworm added to the loss of flowers and bolls already depleted by Sudan bollworm. Not only were yields reduced, but the quality of lint and seed was much below that of the previous season. The staple was shorter and lacking in character, and the percentage of good colour was less than half of the 1947 figure. *Cotton Industry:* Definite progress has been made in both wet and dry processing departments of the Absorbent Cotton Wool Factory. Among the new equipment installed were a Keir boiler and an electrically driven hydro-extractor. *Cotton Research Station:* The results of cotton variety trials and rotation crop trials are recorded. The chief object of the cotton-breeding work is to increase the yield and improve the lint quality, and to establish a variety suitable in habit of growth, and in quick leaf-shedding at senescence, for mechanical harvesting.

281. NEW AGRICULTURAL COLLEGE. (*Rhod. Farmer*, 1/2/50.) The Gwebi College of Agriculture was officially opened in February, 1950. Dr. W. L. Fielding is principal of the college, which is situated 19 miles from Salisbury, on the Sinoia road, at an altitude of 4,800 feet. Gwebi railway station is on the college farm, which is 3,500 acres in extent. Mixed farming is practised and operations are largely mechanized, so that, in addition to their theoretical training, students will be given useful practical experience in modern agriculture. The main subjects in the syllabus are animal husbandry, including instruction in basic biology and chemistry; field husbandry, including basic chemistry and botany; and agricultural engineering and building construction.

282. NEW POWER STATIONS. (*Crown Colonist*, May, 1950, p. 324.) Construction of Southern Rhodesia's largest power station is well advanced at Umniati. A new turbine now being installed at a cost of £250,000 will double the output, and as the demand for electricity grows the new station can be expended to six times its present capacity. At Shanbani construction of a £500,000 power station is to begin soon, and this station is expected to be in operation by 1953. The plant will consist initially of two 5,000 kW. generators, and provision will be made for the addition of further units until a maximum of some 40,000 kW. is reached.

283. SOUTH AFRICA: COTTON CROP. (*Overseas Rev.*, Barclays Bank [D. C. & O.], February, 1950, p. 3.) The Union's cotton crop, after reaching 16,000 statistical bales in 1926, dropped to negligible proportions in the succeeding years, due largely to a drop in world prices. In 1945-46 the crop was only 274 bales, but increased nearly tenfold in the next two years, whilst last year it reached 5,600 bales.

In the present 1949-50 season for the second year in succession the acreage planted has increased threefold and the crop is expected to reach 12,000—15,000 bales. The renewed interest in this crop is ascribed mainly to the large increase in the price of raw cotton in recent years, and also to the fact that planters are now assured of an internal market by reason of the establishment of cotton textile factories in the Union.

284. SUDAN: COTTON CROP, 1949-50. (Dept. Agric. Report, April, 1950.) The third official estimate of the acreage and indicated production for the present season is as follows: Sakel Types, 1,115,700 kantars from 318,916 feddans; American Irrigated, 21,859 kantars from 6,768 feddans; American Rain-grown, 77,500 kantars from 88,680 feddans.

285. ECONOMIC POSITION OF THE COTTON CROP. (*E. Afr. and Rhod.*, 13/4/50.) In a review of the economic position it was stated that the 1949 cotton crop has been above average and the record prices obtained for it brought the value of lint and seed exports to about four-fifths of the total value of export for the country—*i.e.*, £E12,000,000 out of £E26,500,000. The contract with the British Raw Cotton Commission for the sale of the bulk of the Gezira and Government crops proved to be particularly advantageous in that it secured for the Sudan some of the benefit of the higher prices which prevailed in the earlier months of the year before the cotton was available for delivery. The relatively small quantity of 30,000 bales was auctioned at Port Sudan in June, and realized prices considerably lower than those paid by the Raw Cotton Commission. The high prices had been brought about by two factors of an adventitious nature—devaluation, and damage suffered by the new Egyptian crop. Cotton prices would probably be lower next year.

286. COTTON CROP, 1949-50. (*Cott. and Genl. Econ. Rev.*, 3/3/50.) The Government and the Gezira Concession Companies have concluded contracts with the British Raw Cotton Commission for the sale of substantial quantities of the 1949-50 cotton crops. These contracts cover—

The whole output of the top three grades of the Gezira, Gash, White Nile Schemes and Gondal crops of Sakel and Sakel-type cotton.
The whole output of the fourth grades of Gezira Sakel.
15,000 bales from the fourth grades of Gezira Sakel-type.
The whole output of the fourth grades of White Nile Schemes, and Gondal Sakel-type, and
3,000 bales from the lower grades of Gash and Sakel-type cotton.

Prices are to be based on the average of the Alexandria f.o.b. prices during the five months January to May for the comparable Egyptian cotton.

Negotiations took place with the Government of India regarding the possibility of a bulk sale of part of the cotton remaining, but no agreement could be reached. Consequently India's requirements of Sudan cotton will be obtained through normal trade channels.

It is the intention of the Government and the Concession Companies to dispose of the bulk of the cotton not included in the contract with the British Raw Cotton Commission by a series of auctions at Port Sudan, but full considerations will be given to any offers made by private treaty. While it is early yet to indicate how much cotton will be auctioned, it is probable that the quantity will be substantially greater than the amount offered last year.

Of the Sudan's rain-grown American-type cotton, 50 per cent. of the Nuba Mountains crop, and the whole crop produced under the management of the Equatorial Projects Board, have been sold to the British Raw Cotton Commission at 30d. per lb. and 28d. per lb. f.o.b. Port Sudan respectively. The remaining 50 per cent. of the Nuba Mountains crop will be auctioned at Port Sudan.

287. COTTON CROP, RESEARCH PROJECTS. (Ann. Rep. Emp. Cott. Grwg. Corpn., 1949-50.) At the Gezira Research Farm breeding and selection work on Domains Sakel and X.1730 types continued, and once again the blackarm resistant strains significantly outyielded the susceptible strains when severe blackarm infection was present. A new Sakel derivative, BLR.14/16 from Shambat, which carried resistance to both leafcurl and blackarm, showed promise, and work on this strain will be continued.

At Shambat the Economic Geneticist continued his work of transferring to commercial strains resistance to blackarm and jassid. In addition twenty Upland varieties, freshly imported from the Cotton Belt in America, were graded for blackarm resistance, but all proved to be highly susceptible. A project to transfer lint strength from wild cotton to Sakel was continued, samples being sent to the Shirley Institute for testing.

288. TANKANYIKA: COTTON CROP. (Dept. Agric. Rept., March, 1950.) The 1949 prices paid to growers for seed cotton remained the same as those which prevailed in 1948—namely, 24 cents per lb. for No. 1 and 6 cents per lb. for No. 3 quality seed cotton in the Lake Province; and 59½ cents per kilo for No. 1 and 19 cents per kilo for No. 3 qualities in the other cotton-producing areas. The 1949 production amounting to 51,308 bales compares favourably with the 1939-49 average of 48,157 bales.

As regards the 1950 crop, the Lake Province areas were planted later than usual, owing to the delayed rains. The progress of the crop is satisfactory to date, however, and the provisional estimate is set at 45,000 bales.

Good progress is made with the multiplication of UK.46 seed, which it is intended will replace the present MZ.561 cotton being used in the Lake Province. It is hoped that with this coming season's crop of UK.46 there will be sufficient seed of this new strain for the whole of the Lake Province. UK.46 has good jassid resistance, gives higher seed cotton yields and a more satisfactory ginning percentage than MZ.561.

289. UGANDA: CROP PROSPECTS. (Ann. Rep. Emp. Cott. Grwg. Corpn., 1949-50.) On account of delay in the onset of the spring rains a high proportion of the 1949-50 crop was planted late, although the total of 1,628,518 acres showed a slight rise on last year's figures. Unduly dry weather in October and November was responsible for much boll shedding on the earlier planted cotton and for a serious check in the growth of the later planted cotton. For these reasons yields per acre are expected to be low despite the fact that the crop has not suffered unduly from pests or diseases. *Lygus* damages up to the end of February had not been severe and serious blackarm attack had been confined to local outbreaks. The official estimate of the crop, at the end of February, was 320,000 bales.

290. COTTON CROP. (*Overseas Rev.*, Barclays Bank [D.C. & O.], April, 1950.) Buying of the Uganda crop has continued steadily. The season has been extended to April 21. Estimates now place the crop at about 320,000 bales. Ginning of last season's Mwanza crop has been completed and the final figures are 37,378 bales compared with 45,649 bales for the previous season.

291. COTTON CROP. (*Cott. and Genl. Econ. Rev.*, 12/5/50.) The spring rains broke during the second week of April and falls were heavy in most parts of the Protectorate. Marketing was slowed down in the Buganda Zones (including Toro District), but elsewhere the effect was small, as in most other zones buying was practically finished before the onset of the rains. There was a slight lowering of grade during the month, but considering the season as a whole a satisfactory standard has been maintained. Uprooting and burning of cotton plants has been completed except in Buganda, where the season is later than in other provinces. Present indicates are that the original crop estimate of 320,000 bales will be exceeded by 5,000 to 6,000 bales.

292. CENTRAL COTTON RESEARCH STATION. (Ann. Rept. Emp. Cott. Grwg. Corpn., 1949-50.) Considerable progress was made during the year in the development of the Station, and it is anticipated that the laboratories will be completed and ten staff houses occupied by the beginning of the 1950-51 crop season. On the land to be devoted to crop experiments some 20 acres were cleared and planted in the 1949-50 season, the B.P.52 breeding material which had been transferred from the Government Experiment Station at Kawanda forming the main research project. A further 50 acres should be ready for the 1950-51 season, and more will be cleared every year until a total of about 1,500 acres has been reached.

The agricultural system which is to be adopted initially at the Namulonge Station will be one of mixed cropping with three years' rest under grass after three years of arable cropping. Elephant grass, the natural cover, is difficult to handle, so trials with other grasses are being carried out. The use of grass rests will help to retain a good crumb structure in the soil, and soil erosion will also be guarded against by having long narrow fields separated by grass roads running approximately on the contour.

293. PLANTING DATE AND COTTON PRODUCTION IN THE BUGANDA PROVINCE OF UGANDA. By H. L. Manning. See Abstract 373.

294. UGANDA: SOME ASPECTS OF CLIMATE WITH SPECIAL REFERENCE TO RAINFALL. (*E. Afr. Met. Dept., Memoir No.* 5, vol. ii, 1949.) The notes which comprise this memoir are not intended to be an exhaustive treatise upon the climate of Uganda. The aim in preparing them has been to indicate the fundamental variations of rainfall régime with a view to assisting the forecaster. Much of their content is the expression of personal opinion based on experience. It is hoped that the memoir will form the basis for further critical examination and analysis in the future.

295. RAISING LEVEL OF LAKE VICTORIA. (*Crown Colonist*, May, 1950, p. 322.) Following an agreement between the Governments of the United Kingdom, Egypt and Uganda, the Uganda Electricity Board is to increase the height of the Owen Falls dam by 1 metre. This will make it possible to raise the level of Lake Victoria 1·3 metres above the previous recorded maximum, and thus enable water storage to be undertaken—a matter of vital interest to Egypt.

Although it will be many years before this new maximum level is reached, it is considered necessary to determine forthwith the extent to which lakeshore interests may eventually be affected by this proposal, and the Governments of Kenya, Tanganyika and Uganda and the East African Railways and Harbours will each nominate one representative to a committee which will co-ordinate their respective views on questions concerning compensation, and will deal directly with the consulting engineers. The Uganda Government's representative, who will be chairman of the Committee, is Brig. C. G. Hawes, who has hitherto been Chief Civil Engineer to the Uganda Electricity Board and Hydrological Adviser to the Uganda Government.

296. UGANDA: FINANCIAL POSITION. (*E. Afr. and Rhod.*, 2/2/50.) Uganda's accumulated balances, reserve funds, recoverable loans and investments, etc., were estimated at £12,324,000 at the end of last year, and the surplus of 1949 was expected to be £1,352,000 above the estimated £494,000. The budget for 1950 provides for expenditure of £6,823,000 from an estimated revenue of £7,540,000. The accumulated balances stand at £4,685,000, recoverable loans and investments at £425,000. Reserve funds for post-war development schemes amount to £4,715,000, with an additional £1,250,000 in the Cotton and Hard Coffee Development Fund, and £764,000 advanced to the Uganda Electricity Board.

Opening the session of the Legislative Council, the Governor, Sir John Hall, said that it had been decided to increase the export taxes on coffee, cotton and cottonseed on account of revaluation and the consequent rise in export prices. Part of the resulting fortuitous profits would thus be brought into the revenues of the country and inflation would be checked.

297. AUSTRALIA: COTTON INDUSTRY. (*Cott. and Genl. Econ. Rev.*, 5/5/50.) The Australian cotton textile industry continued to expand in 1949. Construction was started on two new spinning mills which are expected to be in operation in the first half of 1950. Some of the established mills installed additional machinery and others continued their modernization by replacing old machinery with modern equipment. However, the expansion of the textile industry has been slowed down by the difficulties of importing equipment and of procuring building materials. As in preceding years, labour was insufficient to operate the Australian mills at anything like full capacity.

During the war Australian mills produced large quantities of duck and drill for the requirements of the armed services. In the post-war years there has been a considerable decrease in the output of such materials and an increase in production of sheetings and other light-weight goods. Although the yardage of piece goods produced has increased, the shift to the production of lighter weight goods has caused the quantity of cotton consumed to decline from the peak reached during the war. However, with the addition of new capacity and if sufficient labour can be recruited, cotton consumption in 1949-50 is now expected to reach or exceed the record high figure of 66,345 bales in 1942-43.

Imports of raw cotton into Australia in the first six months (August through January) of the current season amounted to 26,845 bales, of which 79 per cent. came from Brazil, 12 per cent. from India, 5 per cent. from Pakistan, and the remainder from Egypt and Peru. Because of a dollar shortage practically no raw cotton has been purchased from the United States during the current season. In 1948-49, 6,500 bales were imported from the United States and in 1947-48, 11,460 bales.

Acreage planted to cotton in the 1949-50 season has been estimated at 4,000 acres. Weather conditions generally were favourable for the planting and growth of the crop. The crop, for which harvest has just been started, has been estimated at about 1,000 bales. Although this is above the previous season's crop, this is far under the pre-war level of 8,000 to 15,000 bales.

298. QUEENSLAND: COTTON GROWING IN THE MACKAY AREA. By N. E. Goodchild. (*Queensland Agric. J.*, **70**, 2, 1950, p. 73.) Small areas of cotton have been grown for some years in different parts of the Mackay area, with varying degrees of success. Isolated crops in the Carmila and Ilbilbie districts have produced up to 1,500 lb. of seed cotton to the acre. The latter district appears to offer the greatest possibilities for cotton growing in the Mackay area.

Suitable soils in this district are grey clay loams overlying a previous clay subsoil at a depth of 18 to 24 inches. This soil type appears to offer adequate drainage and at the same time is sufficiently retentive of soil moisture to ensure that growth of the cotton plants is not seriously checked.

Conditions in the Mackay area during the heavy wet season compel planting to be so arranged that there is a good chance of dry weather at harvesting. It has been found by a series of plantings over a number of years that late December planting is the most appropriate time. This generally allows the crop to become established and develop a root system before the wet season sets in. The Ilbilbie soils have sufficient drainage to avoid waterlogging and the crop is grown through January to May and harvested in June and July. Winter rains are often experienced, but are generally of short duration and are not detrimental to the production of good-grade cotton. Overall climatic conditions and soils in the Mackay area are not considered suitable for successful cotton growing.

299. SOIL CONSERVATION IN QUEENSLAND. See Abstract 344.

300. WEST INDIES: COTTON CROP. (*Overseas Review*, Barclay's Bank [D.C. & O.], March, 1950.) Good conditions for picking are reported in Antigua, where the harvest is well under way. The Agricultural Department there report that an unusual phenomenon for the time of year has been the presence in some districts of large quantities of the leaf-eating cotton worm, doing damage to flowers and young bolls. In Nevis the picking of the crop has started and it promises to be much cleaner than the previous crop with a much lower percentage of stained cotton.

301. WEST INDIAN SEA ISLAND COTTON ASSOCIATION. Report of the 5th Ordinary General Meeting. December, 1949. In his opening speech, Mr. J. V. Lochire, the Cotton Officer for the West Indies, stressed the heavy losses suffered by the crop through damage by leafworm and pink bollworm, and urged the need for growers to co-operate in effecting more efficient control of cotton pests.

He gave a brief outline of the agricultural investigations that were being carried out, which included measures for soil conservation and water control, fertilizer experiments and improved cultivation practices, and an attempt to establish cotton growing as part of a mixed farming system.

The Report of the Advisory Committee in England for the year 1949 and of the Negotiating Committee is also included, together with statistics of cotton acreage, lint production and prices.

302. BARBADOS. Ann. Rept. Dept. of Science and Agriculture, 1948-49. The Peasant Agricultural Instructors, in collaboration with the Plant Diseases Inspector and the cotton factory, made strenuous efforts at the beginning of the season to extend the area under cotton in the outlying parishes. Unfortunately, the season was not favourable for cotton and rather disappointing results were obtained by the majority of the peasant growers, although at one of the Agricultural Stations one field of half an acre yielded at the rate of 1,100 lb. seed cotton per acre. The average yield of seed cotton for estates and peasant holdings was 306·7 lb. per acre.

The variety B.1 continued to be used as the standard variety, and the following varieties were used to plant a variety trial (Trial A) at Codrington: B.4, B.4212, B.4301, B.4309, B.4310, B.4401, B.4404, B.4411 and B.4413. Another variety trial (Trial B) was planted using the following varieties which were obtained from the Progeny Row Experiment of the previous year—viz., B.1(3), B.4701, B.4702, B.4703, B.4704, B.4705, B.4706, B.4707 and B.4708. The reaping of these trials took place from early January until the end of February, when yields of over 800 lb. seed cotton per acre were obtained. Further selection will be made from the latter trial in order to determine which varieties will be retained for planting on a plantation scale.

Selection of seed for the progeny row experiment was made from the following varieties: B.1, B.4, B.4301, B.4310, B.4411, B.4309 and B.4404, and yields of over 1,300 lb. seed cotton per acre were obtained. The average maximum lint length has been found to be 60 mm., and from the sales reports it has been observed that the standard of Barbados cotton lint is being maintained.

No pink boll worm was observed during the period under review, and in the majority of instances, attacks by the defoliating worm, *Aletia argillaceae*, were successfully controlled by spraying with lead arsenate.

The experimental cotton-spinning plant has been in continuous operation, and production during the year amounted to 5,413 lb. of five-ply 10's cord of which 2,667 lb. have been sold, and 6,046 lb. of 24's ring yarn of which 5,568 lb. have been sold.

COTTON IN THE U.S.A.

303. Agricultural Statistics, 1949. U.S. Department of Agriculture. (For sale by the Superintendent of Documents, U.S. Govt. Printing Office, Washington, 25, D.C. Price not stated.) This publication brings together each year the more important series of statistics compiled in the Department of Agriculture or in other departments whose work concerns agriculture. The tables selected give a wide variety of facts in forms suited to most common uses. They include statistics of grains, cotton, sugar, tobacco, oilseeds, fats, fruit, vegetable and minor field crops. Also included in this issue are statistics concerning the foreign trade of the United States, and agricultural conservation and forestry.

304. United States: Crop Prospects, 1950-51. (*Cotton*, M/c., 29/4/50.) During the first half of April preparations for the new crop were held back both by rains and abnormally low temperatures. In the Eastern and Central Belts scattered rains have been beneficial for the most part. Temperatures have been unusually low; freezes and frosts covered almost all areas. In consequence, the crop has lost some of its advance in certain sections and has become later in others. However, this lateness can be quickly overcome with more favourable weather conditions and with mechanization.

In Texas and Oklahoma the drought has been broken by much-needed rains over wide areas, but much more rainfall is necessary. The weather has been cool with unusually heavy winds and dust storms. Farmers will make every effort to raise as much cotton as possible, and it is expected that all additional allotments will be applied for. This crop will be cultivated more intensively and scientifically and fertilized more heavily, particularly in the Eastern and Central Belts. In some places the width of the rows is being narrowed and farmers will plant seed heavily to secure good stands. The soil is generally in good condition. Heavy weevil emergence is expected and reported and poisoning will begin early and be used freely, probably to a larger extent than ever before.

305. COTTON CROP 1949-50, FINAL ESTIMATE. (*Cotton*, M/c., 13/5/50.) The United States Department of Agriculture in its final estimate of the 1949 American cotton crop reports the harvest as the largest since 1937 and the fourth largest on record. Final figures show a total of 16,127,000 bales, each weighing 500 lb. This is 8 per cent. above the 1948 crop and 43 per cent. higher than the average for the last ten years.

Exceptionally favourable weather conditions in the large southern state of Texas, which produces over one-third of the nation's total, were cited as a leading factor in the heavy production.

The Department estimated the total value of cotton lint in the 1948 crop at $2,262 million, and of the cottonseed ginned at $286 million.

As the United States Government now has on hand a surplus of more than 5 million bales of cotton acquired under its price support programme, action is being taken to reduce production in 1950. Marketing quotas are being used to enforce a reduction of almost 25 per cent. in areas planted.

306. COTTON CROP 1949-50, SEMI-FINAL REPORT. (*Cotton*, M/c., 22/4/50.) Cotton ginned in the United States from the 1949 crop totalled 15,900,502 bales compared with 14,580,279 bales last season and 11,557,138 bales two seasons ago. This season's crop contained 15,896,778 bales of Upland cotton and 3,724 bales of American-Egyptian. Last season Upland cotton totalled 14,576,814 bales and American Egyptian 3,456 bales. The 1949-50 supply of Upland cotton (carryover plus crop) totals about 21,113,000 bales compared with 17,565,000 bales last season, an increase of 20 per cent.

The grade of this season's crop averaged lower than for any other since 1945. The grade index was 94·2 (Middling=100), compared with 95·7 for 1948 and 96·9 for 1947. The greatest reductions in grade from a year earlier were in Texas, California, Oklahoma and Louisiana. Ginnings this season compared with last season contained the smallest proportion of higher grade cotton of any other crop since the war. There was a sharp increase in the proportion of Strict Low Middling and Low Middling, but that part of the crop grading Strict Good Ordinary and Good Ordinary was substantially smaller than last season. Spotted and other coloured cotton ginned this season comprised a much larger proportion of the total than last season. Ginnings of this cotton were more than 50 per cent. larger than in the previous season.

The average length of Upland cotton ginned this season was 32 thirty-seconds inch, compared with 32·4 thirty-seconds last season and 31·7 thirty-seconds two years ago. There were only three States in which the average staple was shorter than last year. The shorter average length for the United States is due to the sharply increased production in Texas, where the staple length averaged about $\frac{15}{16}$ inch in both 1949 and 1948. The staple averaged considerably longer than last season in Alabama, New Mexico, California and Tennessee. This season's crop compared with that of a previous season contained much larger proportions of the shorter staples, proportionately less of the medium staples and slightly larger proportions of most of the longer staples.

307. SUMMARY OF FIBRE AND SPINNING TEST RESULTS FOR COTTON VARIETIES GROWN BY SELECTED COTTON IMPROVEMENT GROUPS, 1949 CROP. (U.S.D.A., Prodtn. and Mktg. Admin., Cott. Branch., Jan., 1950). Fibre and manufacturing properties of the principal varieties of cotton produced commercially by cotton improvement groups were determined for the 1949 crop and the results are summarized in this report. Recent data are included for cottons harvested late in the season, as well as the results that were published on a monthly basis from August through November, 1949. Earlier publications in this series presented the test data on a geographical basis, whereas in this summary they are generally grouped according to variety. This arrangement affords a more convenient basis for comparing variety performance in various areas, and at the same time permits regional comparisons of quality because the production of a specified variety is often confined to certain geographical areas.

308. AVERAGE COST OF GINNING AND BALING THE 1949 AMERICAN COTTON CROP. (*Cotton*, M/c., 20/5/50.) The average cost to growers in the United States for ginning and wrapping a 500 lb. gross weight bale of 1949 crop cotton was $10·47, according to a report recently issued by the Department of Agriculture. The cost for this service was about 8½ per cent. higher than on the 1948 crop, about 63 per cent. higher than on the 1944 crop, and about 124 per cent. higher than on the 1939 crop. The ginning rates this season compared with those of last season showed very little average net change in the Eastern Belt, but continued to average higher in the other major portions of the Belt. In the sixteen seasons prior to 1939-40 average ginning rates for the Belt as a whole fluctuated within a range of from $6 per bale in the early 'twenties to £4·04 in the 1931-32 season. During the current season they ranged from a low of $7·22 per bale in Alabama to a high of $13·79 in Missouri.

309. AMERICAN COTTON CARRYOVER IN THE UNITED STATES. (*Cotton*, M/c., 20/5/50.) The supply in 1949-50 is estimated at 21·4 million bales. If United States mill consumption approximates 8·5 million bales as expected, and exports are around 5¼ million bales, total disappearance for the full season will be about 13¾ million bales. This would indicate that cotton stocks at the end of the current season are likely to be around 7·5 million bales, of which about two-thirds will be in C.C.C. stocks.

310. COTTON EXPORTS IN 1949. (*Cotton*, M/c., 13/5/50.) United States raw cotton exports in 1949 amounted to 5,150,000 bales and were 87 per cent. higher than the previous year, and the largest for any single year since 1937.

The report states that cotton shipments to E.C.A. countries accounted for most of the 1949 gains. Cotton of a staple length $\frac{15}{16}$ in. to $1\frac{1}{16}$ in. represented the major element in the 1949 shipments. The principal gains over 1948 were made in the following countries: France, a gain of 472,000 bales; United Kingdom, 463,000 bales; Japan, 384,000 bales; Italy, 323,000 bales; Germany, 212,000 bales; Canada, 130,000 bales; and the Netherlands, 127,000 bales. These countries accounted for 90 per cent. of the increase.

311. DEVELOPMENT OF COTTON TEXTILE PRODUCTS. By J. F. Hagen. (*Papers Amer. Assoc. Text. Techgsts.*, **4**, 1949, p. 144. From *Summ. Curr. Lit.*, xxx, **7**, 1950, p. 203.) The background of the cotton industry in America is surveyed and the effect of the rise of the artificial fibres is noted. Rayon has decreased in price but cotton has increased. Reference is made to the report on cotton and its uses issued by the National Cotton Council at Memphis. Research in the field of cotton technology is discussed and it is stated that in the United States research expenditure for cotton has been less than 10 per cent. of that expended by the rayon industry. Some projects for research are mentioned and many ways in which cotton could be improved are suggested.

312. AMERICAN TEXTILE MILLS: MODERN PRODUCTION METHODS. (*Text. Industries*, **114**, 2, 1940, p. 98. From *Summ. Curr. Lit.*, xxx, **9**, 1950, p. 254.) A series of forty-nine short articles is presented, giving actual case histories of what American textile mills are doing to increase production, lower operating costs, improve quality, utilize man-power more efficiently, reduce and control waste, and secure improved operating conditions by the proper use of equipment accessories, and services made available to the industry.

313. GEORGIA: COTTON VARIETY TESTS. (28th Ann. Rept. Georgia Coastal Plain Expmt. Sta. 1947-48. From *Pla. Bre. Abs.*, xix, **4**, 1949, p. 709.) Varietal tests are reported together with tests of commercial varieties and breeders' strains for wilt resistance. Pandora, a variety bred at the station, has given comparatively good yields since 1945. Progress is reported in the breeding of upland cotton. The programme included (1) trials, maintenance and improvement work with Pandora and crossing this variety and its parents with other varieties, (2) work on the development of new strains and (3) hybrid vigour studies.

Several strains quite different from Pandora in plant type are being developed. A plant type suitable for machine harvesting and highly prolific is desired, and there will also be a careful search for cottons possessing resistance to nematodes, diseases and insects. At the same time extensive fibre tests are being carried out. Only high-yielding strains with satisfactory fibre quality will be considered for increase and distribution. From 492 different hybrids grown in 1947, there were 14 which showed enough hybrid vigour, as measured by yield to warrant further study. These gave an increase of 18 to 44 per cent. over the best variety. Crosses are being made to ensure a thorough testing of them in 1949.

Crosses with many inbred lines are being made with a self-sterile strain to determine the possibility of using it for hybrid production, and an attempt is being made to transfer the sterility to a better parent. In other places the cause and manner of inheritance of this character are being studied.

The South Carolina Sea Island cotton-breeding project was transferred in 1948 to Tifton and consolidated with the Georgia Coastal Plain Experimental project. Sea Island Egyptian-Tanguis hybrids are receiving special attention. Many progenies of Sea Island-Egyptian hybrids were in the fourth and fifth generations in 1948 and appear superior to Sea Island in production, picking quality and lint percentage. On the basis of fibre strength tests it is believed that some of the Sea Island-Egyptian combinations will produce fibre equal in strength to any of the present Sea Island lines.

314. COTTON GROWING IN EASTERN OKLAHOMA. By W. F. LaGrone. (*Oklahoma Agric. Expt. Sta. Bull. No. B*-345. February, 1950.) A study of cotton growing methods in eastern Oklahoma was begun in the summer of 1948 with a field survey, the broad objectives of which were as follows: (1) To provide a current picture of production practices of cotton and other major crops; (2) to ascertain the variation in use of fertilizer, insecticides and other improved practices, and in degree of mechanization; (3) to evaluate the economic significance of these production practices and techniques. This publication describes current methods of growing cotton, presents the variation in these methods, and compares present practices with experiment station recommendations. In general it was found that farmers were close to experiment station recommendations on variety, rate of seeding and method of planting and spacing. They were, however, far short of recommendations with respect to fertilization and insect control.

315. OKLAHOMA COTTON VARIETY TESTS, 1944-1948. By I. M. Parrott *et al.* (*Okla. Agric. Expt. Sta., Tech. Bull.* T-37, 1950.) Cotton varieties have been tested at a number of locations in Oklahoma for many years. Results of these tests have been summarized periodically. Because of minor modifications of existing varieties by cotton breeders, and because of the appearance of new varieties, these tests are needed every year. Also because of these changes in varieties, it is not desirable to extend averages over a long period of years. On the other hand, little confidence can be placed in the results obtained in a single year. This bulletin gives a summary of the information collected from the cotton variety trials carried out at four locations in Oklahoma over a period of five years.

316. OKLAHOMA: NEW VARIETIES OF COTTON. ("Cotton Varieties for Oklahoma," *Okla. Agric. Expt. Sta. Bull.* B.343, 1950.) Two new strains of cotton developed at the Oklahoma Agricultural Experiment Station have been tested against commercial varieties. CR-1 is characterized by a prominent central stalk and short lateral branches, resulting in a close fruiting habit. It usually staples $\frac{15}{16}$. CR-2 is a sister selection of CR-1 that has shorter staple, $\frac{7}{8}$ to $\frac{29}{32}$ inch, shorter stalk, more compact boll, and is somewhat more storm resistant. Seed of these two varieties will be available in limited quantities for experimental plantings in 1950.

317. OKLAHOMA: SNAPPED, STRIPPED AND SLEDDED COTTON. By J. D. Campbell. (*Curr. Farm Economics*, 22, 5, 1949, p. 144.) A large part of the 1949 cotton crop in Western Oklahoma was planted late in June and early July. These late plantings and the late summer and autumn rains resulted in a considerable amount of cotton remaining in the fields after frost. A survey made in the spring of 1948 on the use of cotton strippers showed that nine-tenths of the farmers thought the grades of cotton stripped in 1947 and prior seasons had been equivalent to or higher than those of similar hand-snapped cotton. The grade index of the machine-stripped averaged 0·75 below that of the hand-snapped cotton for the 1948 crop, while that for sledded cotton averaged 2·15 lower than for hand-snapped cotton. Nevertheless, in spite of the loss of grade and the increased waste of cotton caused by the use of mechanical strippers, it was proved to be more profitable to adopt this method, provided sufficient volumes were available, than to hand harvest the crop, even when labour was readily obtainable.

COTTON IN EGYPT

318. Egypt: Cotton Crop. (*Cott. and Genl. Econ. Rev.*, 17/3/50.) It is anticipated that the 1950 acreage in Upper Egypt will be between 650,000 and 700,000 feddans, which would normally produce 4,500,000 cantars. In the Delta about 150,000 feddans will be planted to Zagora, giving a yield of 800,000 cantars, and about 400,000 feddans will be planted to Giza 30, giving under favourable conditions a crop of 2,300,000 cantars.

The total 1950 crop of medium and short staples, given satisfactory weather, should reach 7,250,000 to 7,600,000 cantars. The position as regards long-staple varieties (Karnak and Menoufi) is different, as the acreage to be sown to these growths is to be restricted to 700,000 feddans in the north of the Delta. The soil in this area favours the production of high-quality cotton, but gives only a small yield per feddan. According to the latest information, around 575,000 feddans will be planted to Karnak, pointing to a harvest of 2,500,000 cantars, and 125,000 feddans to Menoufi, pointing to a crop of about 700,000 cantars—that is, 3,200,000 cantars in all. It is difficult to estimate the probable end-season carryover of short staples in Egypt, but as regards Karnak and Menoufi a carryover of 650,000 cantars is predicted, which would indicate a total visible 1950-51 supply of less than 4,000,000 cantars.

319. Spinning Test Report on the 1949 Crop. By M. A. Kilany. (Min. Agric. Spinning Test Mill, Orman, Egypt, 1950.) The varieties tested were Amoun, Karnak, Menoufi, Giza 23, Giza 30, Uppers Ashmouni and Zagora. The new varieties on trial were Giza 45, Giza 47 and Giza 31.

Karnak and Menoufi of the 1949 crop were slightly lower in spinning quality compared with the 1948 crop, while the others were about the same quality as last year's crop.

Of the new varieties on trial, Giza 45 was shown to be of a better spinning quality than Amoun. About 650 acres on Government farms have been allotted to this variety in 1950. Giza 47 and Giza 31 are varieties for Upper Egypt; the former is covering about 1,800 acres mainly in Fayoum district, while the latter is sown on about 350 acres in the south zone of Upper Egypt. The expansion of these varieties depends on their success with spinners and growers. All the samples tested were drawn from commercial deliveries.

320. Worms and Laws. By C. H. Brown. (*Egyptian Cott. Gaz.*, **9**, 1950, p. 15.) The first part of this article is concerned with damage to the Egyptian cotton crop caused by the cotton leaf worm and the measures taken for its control. In order to reduce the leaf worm population a law was passed prohibiting the watering of berseem after May 10, as it was known that the leaf worm migrated from berseem to cotton as soon as the latter crop became established. The author points out the advantage of enforcing this law, which at present is widely evaded.

The second part of the article deals with damage caused by bollworms (*Earias* and *Platyedra*), which, though less spectacular than that of the cotton leaf worm, is nevertheless sufficiently serious to warrant the enforcement of control measures. These aim at completing all ginning by March 31 in Upper Egypt and April 15 in the Delta. The object is largely defeated, however, by a tendency among growers to withhold their cotton in hopes of a rising market, and the ginners in consequence being granted an extension of time for dealing with the crop.

321. Cotton Deal. (*Cott. and Genl. Econ. Rev.*, 24/3/50.) The recent barter deal with Russia comprised 100,000 tons of wheat in exchange for 27,000 bales of Ashmouni and 3,000 bales of Karnak. It is rumoured that a second important barter deal is under discussion, involving maize against cotton.

322. Cotton Market. (*Overseas Rev.*, Barclays Bank [D.C. & O.], April, 1950.)

The strong bullish tendency of the short-stapled contract has been maintained during April, and a net appreciation of 15 dollars was registered for the April contract during the month, while June appreciated 26 dollars. The situation is basically unchanged with the bulk of the buying position in strong hands accompanied by an intense interest from numerous bullish speculators. Values marked bear little, if any, relation to the spot value of short staples, as is borne out by the fact that Ashmouni of grades which are not tenderable against futures are worth around $70 only, or say $40 to $50 off contract prices. Deliveries against futures during April totalled 437,000 cantars. In contract to short staples, futures quotations for long staples have been quiet with operations restricted to commercial requirements.

Demand for short staples has been spasmodic and almost entirely restricted to the medium and high grades of Ashmouni with the low grades neglected, except for a few isolated lots sold at sacrificial prices; practically no business has been done throughout the month in Giza 30 or Zagora. Karnak, although somewhat neglected earlier in the month, has more recently come into strong demand. In view of its comparative cheapness in comparison with Ashmouni, local spinners have acquired notable quantities of low grades, while demand for export has been centred around grades of good and above.

323. THE ORGANIZATION OF COTTON MARKETING IN EGYPT. (*Egyptian Cott. Gaz.*, 8, Sept., 1949.) This article gives a clear account of the organizations responsible for marketing the Egyptian cotton crop and describes their functions and powers. It would appear that the Government's decision to reopen the market is fully justified, although a good deal of business is still done by private contract.

324. RAW COTTON EXPORT TAX. (*Cotton*, M/c., 11/3/50.) Advices from Cairo state that the Egyptian Government has decided to double the cotton export tax, beginning on September 1. It will then be £E4 per 100 kilos (220 lb.).

COTTON IN OTHER FOREIGN COUNTRIES

325. ARGENTINA: COTTON CROP. (*Cott. and Genl. Econ. Rev.*, 14/4/50.) The 1949-50 cotton crop now being picked in Argentina is forecast by private sources at about 500,000 bales, which is 50,000 larger than last year's crop and second only to the record crop of 553,000 bales produced in 1943-44. Private estimates of the acreage planted this year range from 1,110,000 to 1,235,000 acres, which exceeds that of any previous year by at least 100,000 acres. Growing conditions were unusually favourable until late February, when some damage to open bolls was caused by excessive rainfall continuing through March.

The quality of the 1949-50 crop may be low as a result of heavy rainfall during harvest. Very little of last year's crop was classed as above Grade C, due to excessive rain, slow harvest, and apparent deterioration of strains being planted. Argentine mills normally use all the better grade cotton and only low grades are offered for export. The supply of labour for this year's harvest is adequate.

Mill consumption has increased steadily from 159,000 bales in 1939 to approximately 410,000 bales in 1949. The number of spindles increased from 331,950 in 1939 to about 500,000 in 1949. The high level of mill consumption is expected to continue, since demand for textiles is still strong, with little competition from imported textiles because of import controls and shortage of exchange.

Stocks of cotton in all positions on March 1, 1950, the beginning of the crop year, were estimated at about 240,000 bales, or slightly higher than the 230,000 bales estimated for a year earlier. Mill stocks in each case were estimated at 185,000 bales. Most of the remaining 45,000 to 55,000 bales were low-grade cotton held by the Government for exportation or as a reserve against future mill requirements. Exports in 1949 were reported unofficially at about 20,000 bales, mostly to Spain. Quantities of low-grade cotton available for export were estimated at between 50,000 and 90,000 bales but prices apparently were too high to move all of it.

The Government has indicated its intention to provide price supports, machinery and credits to promote further expansion of cotton cultivation. Large areas of land are still available for expansion of cotton cultivation when roads, transportation, gins and equipment are provided. The high rate of mill consumption is expected to continue to absorb all the better grades of cotton produced in Argentina. Imports of around 10,000 bales annually have been necessary in recent years to supplement the local supply of high-quality cotton.

326. BELGIAN CONGO: RAPPORT ANNUAL POUR L'EXERCICE 1948. (L'Institut National pour l'Étude Agronomique de Congo Belge, Brussels, 1949. Price F. 150.) This report gives the results of experiments carried out at the Bambesa, Boketa, Gandajika and Lubarika cotton experiment stations in the Belgian Congo. The work has centred chiefly on selection for improved strains of cotton, the control of pests and wilt, and experiments in crop rotation and soil protection.

327. BURMA: COTTON CROP. (*Cott. and Genl. Econ. Rev.*, 24/3/50.) The fourth official forecast of the 1949-50 cotton crop gives production at 4,800 tons, or 26,880 bales of lint, of which 3,800 tons, or 21,280 bales, are likely to be available for export. The total area sown at around 200,000 acres compared with a 1936-41 average of 452,700 acres.

328. BRAZIL: COTTON CROP. (*Cotton*, M/c., 18/3/50.) In its annual report for 1949, the Bolsa de Mercadorias, describing the characteristics of the 1948-49 Paulista cotton crop, states that sowing and initial growth were fairly satisfactory in most areas, but an unusually large number of pests made their appearance, and the supplies of insecticides were inadequate when they were most needed. Owing to heavy rains harvesting conditions in March and April were unfavourable, but in May the situation was reversed, and from that time the harvesting took place in particularly favourable circumstances. There was a slight diminution in quality and in staple length, but satisfactory prices were paid in the interior during most of the season.

329. CHINA: COTTON CROP, 1949. (*Cott. and Genl. Econ. Rev.*, 10/2/50.) The collection of cotton acreage and production data for the 1949 crop has been extremely difficult under civil war conditions. Sources in China, however, have estimated the 1949 crop at about 1,700,000 bales from 5·6 million acres, compared with 2,115,000 bales from 6·3 million acres in 1948. Such a crop is inadequate to meet the needs of mill and home industries, estimated in 1948-49 at about 3 million bales. Imports of cotton will receive a high priority if and when the ports are reopened, because of the importance of the cotton mill industry as a stabilizing factor in the nation's economy. At the same time the new Government will make every effort to raise production to meet domestic needs for cotton.

330. COTTON SPINNING INDUSTRY. By T. K. Hsiang. (*Text. Manftr.*, 75, 1949, p. 455. From *Summ. Curr. Lit.*, xxx, 4, 1950, p. 103.) Cotton spinning is the largest industry in China, employing almost 40 per cent. of the total number of industrial workers. A series of figures is given for the numbers of spindles-in-place in each of the years 1904-1936 inclusive. The effect of the war with Japan which began in 1937 is discussed and figures are given for the number of spindles in use after 1937. The present position of the industry is reviewed and figures for the number of spindles-in-place in various districts in October and November, 1948, are given. The effects of the Communist occupation and prospects of the industry are mentioned. In addition raw material supplies are discussed and domestic production and import figures for raw cotton are given for the years 1919-1948 inclusive. A further table gives the annual cotton yarn production for the years 1927 to 1948.

331. FRENCH EQUATORIAL AFRICA: COTTON CROP. (*Cott. et Fib. Trop.*, 4, 4, 1949.) The 1948-49 cotton season developed normally over most of the growing areas, and the total production obtained from the Tchad and Oubangui-Chari territories at 76,573 tons of seed cotton showed a marked improvement on the outturn for the previous season and equalled the record 1945-46 yield. The Government has established the price to the native grower at 12 francs per kilo of seed cotton.

A ten-year plan for the expansion of production in French Equatorial Africa aims at attaining 42,000 tons of fibre—*i.e.*, 17,000 tons more than the maximum so far recorded. To encourage larger plantings and higher yields, the cotton societies are actively developing a programme based on the following measures: (1) propaganda to bring about more efficient cultivation; (2) the appointment of several supervisors in each cotton growing district to ensure that effective progress is made; (3) intensified efforts to combat insect depredations and plant diseases, and (4) improved ginning methods.

A reserve fund is being built up with the object of stabilising prices at a level which will guarantee the native grower a just remuneration, even in the event of a deterioration in general economic conditions over one or two seasons. This guarantee of a fair price before the crop is grown will give the grower every incentive to increase his acreage and to attend more carefully to cultivation.

332. IRAQ: COTTON CROP, 1949. (*Cott. and Genl. Econ. Rev.*, 24/2/50.) There are two types of cotton grown in Iraq—"Rogers" and "Rogers Akala." This year's crop was entirely "Rogers" and was smaller than those of the two previous years, being about 7,000 to 8,000 bales. It is estimated that this season's exports amounted to about 2,500 to 3,000 bales (of 400 lb. each). It is believed that much of this has gone to Japan, high prices being paid to growers because the exporters can use the foreign currency proceeds in connection with import licences for finished goods granted "without foreign exchange."

333. JAPAN: EXPORTS OF COTTON GOODS. (*Cotton*, M/c., 11/2/50.) Japanese authorities estimate that 800,000,000 yards of cotton goods will be exported during 1950, and large amounts of goods will go to sterling area countries. The All-Japan Cotton Spinners' Association has drawn up plans to purchase 1,300,000 bales of cotton in 1950, 440,000 bales of which will come from outside the United States. Most of the cotton outside of the United States supplies will come from sterling non-dollar areas. Of the 440,000 bales programmed, 200,000 bales will come from Pakistan; 100,000 from Mexico; 50,000 from India; 35,000 from Egypt; 30,000 from either Peru or the Belgian Congo; 15,000 from Argentina and 10,000 from Brazil.

334. MEXICO: COTTON CROP. (*Cott. and Genl. Econ. Rev.*, 17/3/50.) The 1949-50 cotton crop in Mexico is now estimated at about 985,000 bales (of 500 lb. gross), based on nearly complete ginning reports. This estimate is 415,000 bales or 73 per cent. higher than last year's previous record crop of 570,000 bales, and 85,000 bales above the last previous estimate for the current crop year. The area harvested in 1949-50 is now estimated at 1,446,000 acres, representing an increase of 38 per cent. over last year's estimate of 1,050,000 acres.

Yields per acre averaged about 326 lb. in 1949, compared with 261 lb. in 1948. Higher yields in 1949 were attributed to (1) extension of irrigation to additional areas in the Matamoros district, where approximately 50 per cent. of the cotton land is now under irrigation; (2) improved methods of insect control; (3) the use of better seed for planting; and (4) unusually favourable weather during most of the season.

The quality and staple length of the 1949 crop were unusually high, especially the Matamoros crop from which about half of the exports in 1949-50 will be drawn. Surplus from the entire 1949 crop in Mexico is estimated at 700,000 bales, of which about 600,000 bales have already been exported. High yields, high wages, favourable prices and quick disposal of the surplus this year have stimulated considerable enthusiasm for further expansion of cotton acreage in 1950. The acreage is expected to reach 1,725,000 to 1,750,000 acres in 1950, or about 300,000 acres above the 1949 total. Such an increase under favourable weather conditions would result in a crop of at least 1,100,000 bales. The greatest increase is likely to take place in the Matamoros district.

335. PARAGUAY: COTTON EXPORT TAX. (*Cott. and Genl. Econ. Rev.*, 14/4/50.) The Bank of Paraguay announced on March 7, 1950, a reduction in cotton export taxes. This was effected by a new schedule of valuations for tax purposes. The new schedule ranges from 30·30 United States cents a pound for Grade 1 to 9·57 cents for Grades 7 and 8, compared with the previous schedule of 31·30 cents to 10·66 cents respectively. An export tax of 3½ per cent. of these values (f.o.b. Buenos Aires) is levied on sales made in United States dollars or in sterling and 10 per cent. on sales in all other currencies. Preliminary production estimates for 1949-50 indicate a probable export surplus of 60,000 to 65,000 bales of 500 pounds gross weight.

336. RUSSIA: DEVELOPMENT OF NEW VARIETIES OF COTTON. (*Soviet News*, 2025, 1948, p. 4. From *Rev. App. Myc.*, xxix, 3, 1950, p. 153.) Soviet scientists working in Uzbekistan have developed new varieties of cotton which are outstanding in yield, early ripening and resistance to blackarm (*Xanthomonas malvacearum*). Crosses made between American varieties and those of India and Central Asia have yielded a cotton totally immune from this disease, which is the greatest scourge of the crop in the northern and more moist areas.

337. SIAM: INDUSTRIAL DEVELOPMENT. (*Ambassador*, 3, 1950, p. 120.) The Siamese Government have planned several important developments to increase the industrial capacity of the country. Among these is the re-establishment of the textile industry, which before the war had two mills, one-third of which was put out of action in the war because of the bombing of a power station. An electric generator is now to be installed, so that this mill, at Bangsue, will again be able to operate to full capacity, and cotton-seed oil, a by-product of the mill, will be extracted. The weaving mill of the Thai Weaving and Spinning Co., at Wat Soithong, has been taken over, and a contract was recently signed for building a modern textile mill, which will be capable of producing a large supply of cloth for domestic needs. Reorganization and extension of the existing mills is also planned.

338. SYRIA: COTTON CROP. (*Cott. and Genl. Econ. Rev.*, 18/2/50.) For some years past agriculturists in Syria have become more and more interested in cotton growing in view of the very profitable returns given. In the space of two years the areas sown have nearly trebled, and it is expected that in 1950 cultivation will be intensified to a considerable extent. The exceptionally favourable climatic conditions for the current crop have given the cotton a quality which made it sought after in the world markets. The harvest for 1949 has been estimated at about 20,000 tons. Of this production 10,000 tons are expected to be exported.

339. TURKEY: COTTON PRODUCTION AND CONSUMPTION. (*Cotton*, M/c., 11/2/50.) Messrs. Ralli Bros., of London, estimate the Turkish cotton crop for the 1949-50 season at 430,000 running bales of approximately 457 lb. net, compared with 240,000 bales in the previous season.

Consumption in Turkey during the past five years averaged about 180,000 bales. Exports therefore up to last season were on a limited scale, but with this season's greatly increased production, due mainly to the good prices obtainable for cotton and the extension of irrigation schemes, the exportable quantity will be about 270,000 bales, which is more than twice last season's exports. The crop is both saw and roller ginned.

340. COTTON EXPORTS. (*Cott. and Genl. Econ. Rev.*, 12/5/50.) A new law has been promulgated to control the standards of all Turkish raw cotton exported, and will come into force on August 1. Types and grades will be established, and bales will be officially marked after passing through the control examination. The whole scheme is sponsored by the Turkish Ministry of Industry and Commerce, and is designed to bring about an improvement in grading and regularity of cotton shipped abroad.

SOILS, SOIL EROSION AND FERTILIZERS

341. IRRIGATED SOILS, THEIR FERTILITY AND MANAGEMENT. By D. W. Thorne and H. B. Peterson. (Philadelphia and Toronto: The Blakiston Company, 1949. Price $5. From *Nature*, 1/4/50, p. 500.) The authors begin by describing and explaining the basic principles which underlie soil-management practices, and then illustrate the application of the principles to the solution of the many problems that arise from irrigation. Their treatment of the subject is comprehensive, and includes a short account of the history and present extent of irrigation, the nature and problems of arid soils, soil and water in relation to plant growth, the quality, measurement and application of irrigation water, drainage and the management and manuring of the land under all the important irrigated crops. The conditions described are those of the United States, and most of the research work cited is American; but such a wide range of irrigated conditions from extreme aridity to sub-humidity is found, and so much thorough research has been done in the United States, that the great store of information provided will be applicable everywhere that irrigation is practised.

342. INTER-AFRICAN SOILS BUREAU. (Colonial Office Information Dept., 24/4/50.) The Inter-African Information Bureau on the Conservation and Utilisation of the Soil—one of the Bureaux and permanent Scientific Committees which Belgium, France, Portugal, the Union of South Africa and the United Kingdom have established in accordance with the policy of technical co-operation in Africa south of the Sahara—has been set up in Paris at the Museum National d'Histoire Naturelle, 47, Rue Cuvier.

The Bureau gives practical effect to the wish of these countries to see the best use made of the land resources of Africa and to promote the economic and social development of the indigenous population. The Inter-African Soils Bureau will facilitate contact and establish permanent liaison between regional African committees on soil conservation, the Inter-African Pedological Service, and all experts and national and international bodies concerned with these problems.

343. AN EXPLORATORY STUDY OF SOIL GROUPS IN THE BELGIAN CONGO. By C. E. Kellogg and F. D. Davol. (I.N.E.A.C., Ser. Scient. 46, 1949. Price 100 Fr.) Tentative suggestions are made for the nomenclature and definition of the principal great soil groups based upon field studies at selected sites representing important soil regions in the Belgian Congo, and upon laboratory examinations of about twenty-five representative soil profiles. Data are included on mechanical analysis, phosphorus content, organic carbon, *p*H, exchangeable cations, exchange capacity, and clay minerals. The data on soil profiles show clearly the great influence of the forest in garnering mineral plant nutrients and concentrating them in the surface. Suggestions are made regarding the relationships of the soils to various general levels of management, and problems of special significance discussed. The corridor system of shifting cultivation is explained briefly, with examples. Outlines of the problem of using chemical fertilizers on certain soils are suggested, and the present advantages of compost and mixed cultures explained.

A scheme for the rapid extension of detailed soil classification and mapping for the guidance of agricultural advisers is outlined briefly, together with suggestions for correlative soil research.

344. SOIL CONSERVATION IN QUEENSLAND. By J. E. Ladewig. (*Queensland Agr. J.*, **70**, 1, 1950, p. 14.) The extent and the fertility of arable land in Queensland are at present more than adequate to provide all the essential requirements for the present population, but evidence of serious erosion damage has already become apparent. The immediate introduction of soil conserving methods of land utilization is essential if the last resources are to provide a satisfactory standard of living for the future population of the State.

Queensland has a serious water erosion problem affecting both agricultural and pastoral lands, but fortunately the incidence of wind erosion is restricted to isolated parts of the west of the State and is comparatively unimportant. This article therefore deals mainly with conditions influencing water erosion and outlines the measures necessary to prevent and repair such damage.

345. NITRATE ACCUMULATION IN A UGANDA SOIL. By G. ap Griffith and H. L. Manning. (*Trop. Agric.*, xxvi, 7-12, 1949, p. 108.) Previous work carried out in Uganda had shown variations in nitrate nitrogen of a soil under coffee with different ground treatments. As the quantities of nitrate then found were of somewhat higher order than those commonly reported in the literature, it was decided to reopen the inquiry. The present paper reports the preliminary phase of a new series of observations made at the Kawanda Agricultural Research Station, Uganda.

The results of a year's observations indicate clearly that, under the conditions at Kawanda (medium rainfall and medium textured soil), a considerable accumulation of nitrate-nitrogen occurs on bare soil during the rainy seasons. This accumulation is equivalent in amount to a very heavy dressing of a nitrogenous fertilizer. There is an unexplained diminution during the dry periods. Under a grass mulch, nitrate content is appreciably lower than that for bare soil.

346. USE OF MICROPLOTS IN A RECONNAISSANCE SURVEY OF THE NUTRIENT STATUS OF THE SOILS OF ZANZIBAR ISLAND. By G. E. Tidbury and W. E. Calton. (*E. Afrn. Agric. J.*, xv, 3, 1950, p. 108.) The soil microplot is a method of assessing the response of a soil to external factors, such as the application of fertilizers, in terms of the green weight of a particular plant, the most common one being maize. The chief value of the microplot lies in its cheapness and the rapidity with which a result is obtained as compared with the orthodox field experiment. Several microplots can be established for the same cost as one large field trial and, within the recognized limitations of the microplot method, give results which are particularly acceptable because they are based on a number of assays.

Microplots were first described by Holme (1944), who used this method to assess the needs of sugar-cane fields in Jamaica for the major plant nutrients. The results obtained enabled him to forecast with considerable accuracy increases in the weight of cane which would result from given dressings of sulphate of ammonia. In the discussions which followed the publication of this work it was pointed out that the second aspect of the microplot was its use as a means of soil survey. It is this second use of the microplot which is described in the present paper. The results of the microplots show remarkable consistency and, in the opinion of the writers, give a more forceful impression of the needs of each soil type than could have been given by the relatively few full-scale trials which could have been undertaken with the same resources.

STATISTICAL TREATMENT, CULTIVATION, GINNING, ETC.

347. THE CORRIDOR SYSTEM OF CULTIVATION IN THE TROPICS. (*E. Afr. and Rhod.*, 18/5/50, p. 1152.) In a report of an address given by Mr. W. V. Blewett on the use of artificial fertilizers in East Africa, it is stated that the corridor system is primarily intended to increase food crop production while avoiding the damage to the soil which results from unsound methods of cultivation. The two principles to be observed in tropical cultivation of light forest soils are, firstly, that they must be protected from the sun as much as possible, and stirred or dug as little as possible; and, secondly, that the plants themselves must receive the maximum amount of light (a condition necessitated by the limited period of daylight.) Furthermore, conditions should be favourable to forest re-establishment as soon as cultivation ceases.

These principles are put into practice by clearing and cultivating narrow corridors running east and west, so as to be exposed to the sun all day; by growing mixed crops (giving good soil cover or shade) as much as possible; and by planting towards the end of the cultivation period crops which favour the return of forest plants. The total period of cultivation after clearing is three to four years.

These corridors are 100 metres wide and a mile or so long. Next to a cultivation corridor is a forest belt of 100 metres, then a cultivation corridor, and so on. By having several of these in a block to be worked from one African village, there will be time for the first corridor to have been under forest for say twelve to fifteen years after cultivation before it is again cultivated.

348. MIXED CROPPING OF GROUNDNUT AND COTTON. (*Ind. Cott. Grwg. Rev.*, 3, 4, 1949, p. 209.) Experiments conducted at the Agricultural Research Station, Lam, Guntur District, on mixed cropping of groundnut and cotton in the proportion of eight of the former to one of the latter showed that the yield of bunch groundnuts was not affected and that cotton recorded yields ranging from 260-380 lb. of seed cotton per acre. Both cotton and groundnut were sown on July 22, 1948, and groundnut was lifted on November 12, 1948. Among the various varieties of cotton tested for mixed cropping, cotton types from U.P. happened to be the earliest, and the next in order being 197-3 from East Khandesh and 881F from Adoni. U.P. types being early, shed flowers and bolls, while the others escaped this defect by their late maturity and are of better quality and ginning outturn. Farmers of the Ceded Districts, the Circars and Nellore are advised to give this mixed cropping a trial, since even at a modest estimated average production of 50 lb. of lint per acre it should be possible to produce 2 lakhs bales extra.

349. Average Cost of Ginning and Baling the 1949 American Cotton Crop. See Abstract 308.

350. Saw Ginning. By W. R. Palmer. (*Egyptian Cott. Gaz.*, **9**, 1950, p. 11.) In this article the author sets out certain advantages of saw ginning over roller ginning and suggests that experiments on saw ginning the Egyptian cotton crop should be undertaken.

351. Note on Comparative Ginning Tests made at Upcountry Ginning Factories and at the Laboratory. By R. L. N. Iyengar *et al.* (*Ind. Cott. Grwg. Rev.*, **3**, 4, 1949, p. 194.) In order to make a systematic study of the processes relating to pre-cleaning and ginning of Indian cottons a Ginning Section was added to the Technological Laboratory, Matunga, in 1941, and since then experiments have been conducted with different varieties of Indian cotton on different types of pre-cleaning and ginning machines. Since the atmospheric conditions of humidity and temperature at Bombay are likely to be different from those at an upcountry ginning factory, it was felt that the ginning tests made at the laboratory may not be fully representative of the general ginning practice. Hence it was decided to make comparative ginning tests at the laboratory and at upcountry factories, keeping identical settings and noting down the atmospheric conditions. Three series of tests were undertaken on three cottons, M4, 124F and Jarila, and the following conclusions were drawn:

(1) There was practically no difference in the ginning percentage or in the quality of lint, whether the sample was ginned at the laboratory or at the ginning factory, when proper allowance was made for the normal variation existing between gins of the same type and for the defects noted in any particular gin. Thus the results obtained at the laboratory are applicable to ginning factories.

(2) The time of ginning produced little effect on the ginning percentage and on the quality of lint, both at the laboratory and at the factory, in spite of the considerable changes in temperature and relative humidity between morning and afternoon at the factory.

(3) The type of gin employed for ginning, however, produced significant effect both on the ginning percentage and on the quality of lint at both places. The saw gin gave lower ginning percentage than the roller gin; but the saw-ginned lint was more regular in length and generally gave yarns of higher strength than roller-ginned lint.

COTTONSEED AND COTTONSEED PRODUCTS

352. Cottonseed and Peanut Meals and Proteins: Electrophoretic Analysis. By M. L. Karon *et al.* (*J. Phys. and Colloid Chem.*, **54**, 1950, p. 56. From *Summ. Curr. Lit.*, xxx, 7, 1950, p. 193.) Cottonseed and peanut meals have been analysed electrophoretically. The factors investigated were (1) the effect of the kind of buffer used in the electrophoretic analysis, (2) the *p*H of the buffer, and (3) the effect of the solvent used to extract the protein from the meal. Peanut protein consists of two major and several minor components. The major components migrate as a single entity under most conditions. Cottonseed meal protein has two major and two minor components. By fractional precipitation involving a change of ionic strength of the sodium chloride solution which was used as the solvent, purified fractions of the major components could be obtained.

353. Cottonseed Grading in Pakistan. See Abstract 262.

MACHINERY

354. Mysore: Mechanization of Agriculture. (*Indian Farming*, x, 8, 1949, p. 350.) The Department of Agriculture in Mysore has recently launched a State-wide tractor service. The Department owns about 135 tractors and they have been stationed, in units of 12 to 14 tractors, in each district under a supervisor and a tractor mechanic. These machines are hired out for ploughing at Rs. 4 per acre of virgin land and Rs. 8 per acre of cultivated land against the actual cost of about Rs. 18 per acre. The lower rates for virgin land are intended to enable the cultivators to bring more fallow land under cultivation. There is a keen and growing demand for tractor service in all parts of the State, and it is therefore proposed to constitute Tractor Advisory Committees to decide questions of allocation and priority so as to get the maximum benefit from the service.

355. SNAPPED, STRIPPED AND SLEDDED COTTON IN OKLAHOMA. See Abstract 317.

PESTS, DISEASES, AND INJURIES, AND THEIR CONTROL

356. CHEMICAL ATTRACTIONS FOR INSECTS: SEX- AND FOOD-ODOURS OF THE COTTON LEAF WORM AND THE CUT WORM. By B. Flaschenträger and El Sayed Amin. (*Nature*, 11/3/50, p. 394.) As a result of investigations carried out on the cotton leaf worm (*Prodenia litura*, Fab.) and the cut worm (*Agrotis ypsilon*, Rott.), the most harmful pests of cotton in Egypt, it was discovered that the female moths attract the males by emitting an odour from one or more chemical substances, and not by sound or radiation. For the purpose of this investigation the authors have invented an apparatus described as an odour-analyser which has enabled them to study sex- and food-odours chemically and biologically simultaneously. With this apparatus the sex-odour of the cotton leaf worm was found to be a volatile, neutral substance or mixture which could be frozen out at − 20°C. It was stable against dilute sulphuric acid and dilute sodium hydroxide. With concentrated sodium hydrogen sulphite they were able to extract the sex-odour from the air-stream. This suggested the presence of an oxo-group in the molecule.

357. HORTEX—A NEW INSECTICIDE. (*World Crops*, **2**, 5, 1950, p. 221.) The Chemische Fabrik E. Merck, Darmstadt, Germany, has developed a new insecticide, called Hortex, which is said to kill practically instantly on contact only. It is a benzene hexachloride compound with, it is claimed, a 98 to 100 per cent. gamma isomer content. Because of its high purity it is said not to taint treated crops. It will be manufactured in powder or liquid form and be used initially for the extermination of the potato beetle.

358. COTTON INSECT CONTROL WITH ORGANIC INSECTICIDES. By J. G. Watts. (*J. Econ. Entom.*, **41**, 4, 1948, p. 543. From *Rev. App. Entom.*, **37**, 12, 1949, p. 459.) Experiments on the control of cotton insects were carried out in South Carolina in 1947, when the season was very favourable to the boll-weevil (*Anthonomus grandis*, Boh.), the insecticides being applied in a manner that approximated to large-scale field operations. Dusts were applied with tractor-mounted dusters at the rate of about 8 lb. per acre and a proprietary spray stated to contain 0·5 per cent. lead arsenate, 0·4 per cent. calcium arsenate, 0·13 per cent. pyrethrins and 21 per cent. mineral oil with a horse-drawn tractor sprayer at about 1·25 U.S. gals. concentrate per acre. In a plot experiment in which the insecticides were applied five times between June 20, when square infestation averaged about 36 per cent., and August 7, about a fortnight before harvest began, the percentages of squares punctured by *Anthonomus*, the numbers of aphids (*Aphis gossypii*, Glov.) per sq. inch and the yields, in lb. seed cotton per acre, were 47·17, 54·9 and 570·2 for no treatment, 30·78, 19·9 and 1,014·5 for a dust containing 5 per cent DDT and 3 per cent. γ BHC (benzene hexachloride), 30·72, 23·6 and 913·1 for 4·8 per cent. γ BHC, 36·88, 39·6 and 838·8 for 20 per cent. chlorinated camphene (toxaphene), 38·61, 67·9 and 781·3 for calcium arsenate with 1 per cent nicotine, and 45·81, 48·6 and 634·3 for the spray concentrate diluted 2 : 23; the least differences required for significance were 4·14, 9·99 and 122·98. The bollworm (*Heliothis armigera*, Hb) was generally unimportant, though it caused limited damage in plots treated with 4·8 per cent. γ BHC. Red spiders (*Tetranychus*) were of no importance. In a second test, each of the four dusts was applied to two or more fields under normal commercial conditions with results that confirmed those of the first test, but their significance was reduced by the very low yield in the controls.

Because of the potential widespread use of chlorinated hydrocarbons on cotton and other crops, it is important to know the extent to which they may accumulate in the soil and become toxic to growing plants. Nineteen different crops were therefore sown in a heavy soil (Grady sandy loam) and a light one (Norfolk sandy loam deep phase) that had been treated the same day with 50 per cent. DDT, 6 per cent. γ BHC or 36 per cent. toxaphene at five different rates (40, 100, 200, 400 and 2,000 lb. per acre). The insecticides were applied by hand in the drill, approximately an inch below the seed. On the heavy soil, there was no apparent injury to any of the crops by any rate of DDT or toxaphene, but all showed light to severe reduction in stand when 6 per cent. γ BHC was used at 2,000 lb. per acre, and all except cowpeas and lima beans showed very light to moderate reduction in stand when it was used at 400 lb. per acre. At 200 lb. it caused a reduction in stand in grain sorghum only, and no injury was apparent on any of the crops in soil treated with 40 or 100 lb. per acre. Even at the higher rates, some of the plants survived and matured normally. An irregular stand of most crops on the light soil made accurate comparisons impossible, but no injury was apparent to any crop at any rate of DDT or toxaphene, though injury from BHC was relatively more severe than on the heavier soil.

359. TESTS OF INSECTICIDES FOR THE CONTROL OF SEVERAL COTTON INSECTS. By J. C. Gaines and H. A. Dean. (*J. Econ. Entom.*, **41**, 4, 1948, p. 548. From *Rev. App. Entom.*, **37**, 12, 1949, p. 460.) Investigations on some of the newer insecticides for the control of *Psallus seriatus*, Reut., *Anthonomus grandis*, Boh., *Heliothis armigera*, Hb., and *Aphis gossypii*, Glov., on cotton were continued in Texas in 1947. The results of three experiments indicated that 1 per cent. parathion or 5 per cent. chlordan in an inert dust and 1 per cent. γ BHC (benzene hexachloride), 5 per cent. DDT and 5 per cent. chlorinated camphene (toxaphene) in sulphur were effective against *P. seriatus* and gave economic increases in yield when applied once in late June. Sulphur alone was less effective. In a factorial experiment destined to afford valid comparisons between different insecticides, acting both as contact and as stomach poisons against all cotton insects, applications of 5 per cent. DDT in sulphur decreased the fleahopper population but did not affect the yield; 20 per cent. toxaphene in sulphur and 3 per cent. γ BHC with 5 per cent. DDT in sulphur gave significantly better control of *H. armigera* and higher yields than calcium arsenate, but all three were equally effective against Anthonomus and only calcium arsenate caused increases in the Aphis population. In another test on five-acre plots, the mixture of BHC, DDT and sulphur gave better control than calcium arsenate of *H. armigera*, but not of *A. grandis*. It gave better control of the weevil than 20 per cent. toxaphene in sulphur and resulted in the highest yield. Toxaphene was more effective against *H. armigera* at 20 than at 10 per cent.

In a randomized block experiment, in which *H. armigera* was the primary pest, 20 per cent. toxaphene in sulphur and the mixture of BHC, DDT and sulphur gave significantly better control than 20 per cent. chlordan in an inert dust, or calcium arsenate, which were equally effective, but there were no significant differences between yields. Calcium arsenate was as effective as the organic compounds in sulphur against *A. grandis*, but the organic dusts did not cause increases in the numbers of Aphids. Parathion and BHC were effective in reducing heavy populations of *Aphis gossypii*.

360. CONTROL OF COTTON INSECTS IN ARIZONA BY BENZENE HEXACHLORIDE AND OTHER INSECTICIDES. By W. A. Stevenson and W. Kauffman. (*J. Econ. Entom.*, **41**, 4, 1948, p. 583. From *Rev. App. Entom.*, **37**, 12, 1949, p. 465.) In Arizona, the control of the Mirids, *Lygus* spp., *Creontiades femoralis*, Van G., *Adelphocoris superbus*, Uhl., and *Psallus seriatus*, Reut., and the Pentatomids, *Euschistus impictiventris*, Stål, *Chlorochroa sayi*, Stål, and *Thyanta custator*, F., is the most serious problem in cotton growing, and BHC (benzene hexachloride), DDT and other insecticides were tested against them in 1946.

In an experiment with dusts applied to two fields at 20 lb. per acre by aeroplane five times in August-September, 5 and 10 per cent. DDT in sulphur and BHC dusts containing 1 and 2·5 per cent. γ isomer increased the yields by 410-422, 247-685, 355-487 and 329-450 lb. per acre. In another test in which 5 per cent. DDT in sulphur and BHC dusts (1 and 2 per cent. γ isomer, respectively) were applied at 20 lb. per acre on August 3 and 16, the insect populations were low in both plots except just before August 12, when an influx of Pentatomids brought the mixed populations to a peak of 58 per 100 sweeps with a net in the DDT plot and 26 in the BHC plot; the populations dropped to 6 per 100 sweeps in the DDT plot and 2 in the BHC plot after August 16 and remained low for the rest of the season. The yields were 2,776 lb. per acre for DDT and 2,311 for BHC. In a field in which the populations of injurious Hemiptera were extremely low throughout the season, with *Lygus* and *P. seriatus* predominating, three applications in August of 20 lb. per acre of 5 per cent. DDT in sulphur and BHC in 50 per cent. sulphur (2 per cent. γ isomer) resulted in average yields of 2,001 and 2,253 lb. seed cotton per acre, respectively, as compared with 1,943 for no treatment. Various fields in southern Arizona were treated with 15-20 lb. per acre of a dust containing 20 per cent. sabadilla against Pentatomids; control was good in most fields, but not in all.

Aeroplane applications of a concentrated BHC spray at 3·4 U.S. gals. (4 oz. γ isomer) per acre on August 14 reduced the number of Pentatomids per 100 sweeps 22 hours later from twelve to three and the number of Lygus from four to none. In one hand-dusting test in which DDT, paris-green and BHC dusts were applied at about 20 lb. per acre four times in July-August, the increase in yield was greatest for 10 per cent. DDT in sulphur and least for paris-green; and in another, dusts containing 5 and 10 per cent. DDT, 2 per cent. γ BHC and 25 per cent. Ryania, applied at the same rate in late July and August, resulted in increases of 398, 194, 37 and 273 lb. per acre; the 10 per cent. dust in the second test had poor dusting qualities.

Laphygma exigua, Hb., causes some damage to seedling cotton in Arizona every year, but usually disappears when the cotton begins to form squares. The first generation is usually highly parasitised, but this was not so in 1946, when the second and third generations caused damage to the squares and blossoms similar to that due to *Heliothis armigera*, Hb. Complete control was obtained, however, with one application of 5 per cent. DDT in sulphur at 15-20 lb. per acre. Control of *H. armigera* was also obtained with the same dust applied at 20-25 lb. per acre, and it is concluded that this is the most satisfactory insecticide for general use against cotton insects in Arizona.

361. ANGULAR LEAF SPOT OF COTTON AND SEED TREATMENT TRIALS. By N. Kaşkaloğlu. (*Mahsul Hekimi* [*J. Plant Prot.*], **2**, 10/11, p. 234; 12, p. 268, 1949. From *Rev. App. Myc.*, xxix, 3, 1950, p. 153.) In some fields in Manisa Province, Western Anatolia, the incidence of angular leaf spot (*Xanthomones malvacearum*) reached 100 per cent. in 1949, but the average rate of infection was 40 per cent. The pathogen was isolated on a medium of dextrose and cotton juice. The percentages of diseased plants produced by infected and healthy seed were 35 and 14, respectively. In seed-dressing experiments the best results were obtained with sulphuric acid, which completely eliminated infection from the stands of the three sowings made on June 7, July 7, and August 13, as compared with 14, 30, and 28, and 35, 20, and 31 per cent., respectively, in two lots of controls. The corresponding figures for graminon were 0, 11 and 13, and for tillex 0, 3 and 2 per cent., respectively.

In a final series of tests, concentrated sulphuric acid and formalin reduced the incidence of blackarm in the uninoculated controls from 26·8 per cent. to nil, but their application presents difficulties. Excellent results were also obtained with tillex (0·24), dry fusariol (0·67), and verisan (0·68), the corresponding figures for fusariol-neu, chloroble, and graminon being 0·91, 2·2 and 2·9 respectively.

362. CONTROL OF BOLL WEEVIL AND COTTON APHIS WITH DUSTS CONTAINING CHLORINATED CAMPHENE, BENZENE HEXACHLORIDE OR OTHER INSECTICIDES. By K. P. Ewing and C. R. Parencia. (*J. Econ. Entom.*, **41**, 4, 1948, p. 558. From *Rev. App. Entom.*, **37**, 12, 1949, p. 461.) Several experiments were carried out in Texas in 1947 on the value of some of the newer insecticides against *Anthonomus grandis*, Boh., and *Aphis gossypii*, Glov., on cotton. In a small-plot experiment at Wharton, the yields of cotton dusted with calcium arsenate and dusts containing 5 per cent.

γ BHC (benzene hexachloride), 3 per cent. γ BHC with 5 per cent. DDT, and 20 or 10 per cent. chlorinated camphene (toxaphene) showed no significant differences, but the least weevil control and the lowest yield were obtained from the plots treated with 10 per cent. toxaphene. *A. gossypii* caused no damage in any of the plots, though infestation was increased by the calcium arsenate and reduced by the other dusts. In five large-scale experiments in the same district, 20 per cent. toxaphene gave slightly better and 10 per cent. toxaphene slightly poorer control of *Anthonomus* than calcium arsenate. The Aphid caused considerable damage in most of the plots dusted with calcium arsenate, but not in those treated with toxaphene. As a result of the combined control of weevils and Aphids, both concentrations of toxaphene resulted in higher yields than did calcium arsenate. In experiments in which the dusted plots were strictly comparable, 20 per cent. toxaphene and calcium arsenate increased the acre yields over no treatment by 539 and 360 lb. respectively, and 10 per cent. toxaphene and calcium arsenate increased them by 494 and 211 lb.

In a small-plot experiment at Waco, where both weevils and fleahoppers (*Psallus seriatus*, Reut.) were injurious, plots dusted with calcium arsenate and 10 and 20 per cent. toxaphene produced significantly more cotton than untreated ones. The toxaphene dusts were significantly better than calcium arsenate, and there was no significant difference in yield between the two concentrations. In a second experiment, in which calcium arsenate, 5 per cent. DDT with 2 or 3 per cent. γ BHC, 3 per cent. γ BHC and 2 per cent. parathion were applied on July 9 and 14, all treatments significantly reduced infestation by the weevil, but were followed by an outbreak of the bollworm (*Heliothis armigera*, Hb.), so that the yields were less than in the controls. In another test, calcium arsenate, 20 per cent. toxaphene alone and with 1 or 2 per cent. parathion and 10 per cent. toxaphene with 2 per cent. parathion all gave significant control of the weevil, with no significant difference between them, and only calcium arsenate resulted in Aphid increase, but the addition of 2 per cent. parathion to 20 per cent. toxaphene slightly reduced the weevil control given by the latter alone. In a fourth test, dusts of 2 per cent. γ BHC in the regular calcium arsenate or 1 or 2 per cent. in a special calcium arsenate prevented an increase in Aphid infestation over that on untreated plants, whereas 1 per cent. in the regular calcium arsenate allowed it to increase significantly, though calcium arsenate alone increased it much more.

363. TOXICITY OF SEVERAL CHLORINATED HYDROCARBONS TO THRIPS ON COTTON. By L. C. Fife *et al.* (*J. Econ. Entom.*, **41**, 4, 1948, p. 665. From *Rev. App. Entom.*, **37**, 12, 1949, p. 476.) In tests against *Thrips tabaci*, Lind., on seedling cotton at Bayview, Texas, in the spring of 1947, various dusts were applied to plots at rates of about 9-12 lb. per acre early in the morning of May 1, when the plants were wet with dew and the air was fairly calm. Counts made twenty-four hours later showed that all had reduced the thrips populations by 96-100 per cent., and counts after five days showed percentage reductions of 99, 98 and 93 for 20, 10 and 5 per cent. chlorinated camphene (toxaphene) in pyrophyllite, 76 for 5 per cent. DDT, 63 for 2·5 per cent. DDT with 0·25 per cent γ benzene hexachloride, and 71 for 5 per cent. chlordan.

364. LOCUSTS. By B. P. Uvarov. (*Corona*, **2**, 5, 1950, p. 180.) Locusts occupy a unique position amongst agricultural pests of tropical countries, by virtue of two salient points in their biology. The first is the irregular periodicity of their visitations, which in the past has been a potent factor against continuity of anti-locust work; the second is the vast migrations of swarms, which make the problem of their control practically insoluble within a single territory. During the last twenty years, however, great advances have been made in the study of locusts and in their control. In the present article, the author does not attempt to summarise this scientific progress, but rather describes how the present knowledge is being used as the basis of a rational approach to the solution of the locust problem.

365. LOCUSTS: INTERNATIONAL CONFERENCE IN PAKISTAN. (*World Crops*, **2**, 3, 1950, p. 113.) At the invitation of the Pakistan Government, locust experts from the United Kingdom, India, Pakistan, France, Persia, Egypt and East Africa have met at Karachi to discuss the renewed menace of the desert locust. Dr. Uvarov, director of the Anti-Locust Research Centre in London, attended the meeting.

Reports indicate the presence of increased locust swarms in Arabia, Pakistan, India and French West Africa, which may denote the beginning of a new widespread locust plague. A detailed programme has been drawn up for immediate operation on a large scale and a wide measure of international co-operation achieved.

It was recommended that the organization in Pakistan for giving warning and controlling locusts should maintain its efforts and assist in measures to control locusts in the Oman which is regarded as a crucial area for the next campaign. Pakistan is to supply equipment and three field officers with local experience. India and Persia should also supply two vehicles. In addition, these three countries should each contribute £1,500 to a fund to provide dusting machinery and camel transport.

366. TSETSE RECLAMATION IN EAST AFRICA. (E. Afr. High Commsn., Research and Scientific Services, 5th Progress Rept., Aug.-Dec., 1949.) Valuable information on anti-tsetse measures has been obtained in Nyanza Province, Kenya, where problems of reclamation concern *Glossina palpalis* and *G. pallidipes;* and in the Iringa and Tabora districts of Tanganyika, where *G. pallidipes* and *G. morsitans* threaten to encroach on to land occupied by Europeans and Africans. One particularly encouraging discovery is that some of the common species of tsetse are usually concentrated in relatively narrow interzones of vegetation, and bush-clearing in these strips alone has a significant effect on the fly population.

367. REPORT ON COLLECTION AND SHIPMENT OF *Trichopoda Pennipes*, 1949. By F. L. Simmonds. (Commwth. Bureau of Biological Control, photostat report, undated.) This report gives an account of the method of collection, cost of collection and arrangements made for transporting a consignment of *Trichopoda pennipes*, the parasite of *Nezara viridula*, from Florida and other south, south-western and eastern States of the U.S.A., to Antigua on behalf of the British West Indian Cotton Growers' Association, and to Australia on behalf of the Australian Government. The *T. pennipes* travelled successfully; 1,649 puparia were received in Australia and 1,475 in Antigua.

368. PLANT PATHOLOGY. By Sir Edwin J. Butler and Dr. S. G. Jones. (London: Macmillan and Co., Ltd., 1949. Price 63s. From *Nature*, 11/2/50.) The first part of the work is concerned with general principles and was written mainly by the senior author. It comprises nine chapters, with an appendix on the classification of fungi. It deals with: (1) the nature of disease organisms, (2) the life-histories of parasitic fungi, (3) the parasite in relationship with its host, (4) resistance and susceptibility, (5) the influence of environmental and nutritional conditions on plant diseases, (6) morbid anatomy, (7) the principles of plant disease control, (8) virus diseases, and (9) deficiency diseases. It constitutes an excellent introduction to the detailed discussion of selected diseases which comprises the second part. The chapter on morbid anatomy, a subject of special interest to the senior author, is particularly noteworthy, and that on control gives, *inter alia*, a brief but authoritative account of quarantines that is refreshing to read.

The second part gives detailed accounts of selected diseases, separate chapters being devoted to diseases of the following host groups: cereals, pasture and forage crops, potatoes and root crops, pulse crops, vegetables, fruit, ornamental and other plants, and trees. The treatment throughout is excellent. A short historical introduction is usually followed by a description of symptoms, the causal agent of the disease, its physiological characteristics, life-history and control; but the method adopted is by no means stereotyped. The information available is presented in a fully assimilated form with copious references to original papers, cited in a bibliography appended to the account of each disease.

369. CHARCOAL ROT OF PLANTS IN EAST TEXAS. By P. A. Young. (*Texas Agric. Expt. Sta. Bull.* 712, Sept., 1949.) Charcoal rot caused by a fungus named *Macrophomina phaseoli* has been reported in at least 284 species of plants. Retting of the bark of the base of the stems and tops of the taproots so that it is easily scraped, and black sclerotia of *M. phaseoli* on the inner side of the bark and in the hard wood of the tap roots characterize charcoal rot of cotton. The cotton plants shed their leaves as they die. These symptoms are easy to distinguish from those of *Fusarium* wilt and *Phymatotrichum* root rot of cotton. In Houston county in October, 1948, nine fields of cotton totalling nearly 250 acres showed 1 to 70 per cent. of the plants with charcoal rot. Five of these fields showed 10 to 70 per cent. of the plants to be dead with charcoal rot as the only apparent cause.

370. VESICULAR-ARBUSCULAR MYCORRHIZA IN SEA ISLAND COTTON AND OTHER TROPICAL PLANTS. By A. Johnston. (*Trop. Agric.*, xxvi, 7-12, 1949, p. 118.) Vesicular-arbuscular mycorrhiza occurred in 86 per cent. of species examined in a representative sample of the Trinidad flora. Although it was common in each of the six ecological habitats surveyed, the proportion of mycorrhizal species and the intensity of infection varied; both were greatest in forest soils of comparatively high organic matter status. Mycorrhizal species were least common amongst herbs or shrubs growing as weeds of cultivation or constituents of "secondary bush." Two types of endophyte were recognized, differing in the mode of degeneration of the fungus in root cells. These are termed the "sporangiolar" and "intracellular hyphal" types. The latter was commoner in all groups of plants examined, except weeds.

In Sea Island cotton, mycorrhiza was affected by the soil, that with abundant organic matter being most favourable to its development. A pot experiment showed that mycorrhiza was not essential for growth in young cotton plants, but varied in importance with soil conditions. It was beneficial in poor soil and possibly in that rich in organic matter, whereas in the presence of plentiful inorganic nutrients and little organic matter it has no effect.

371. *Xanthomonas malvacearum:* RESISTANT STRAINS OF COTTON PRODUCED IN RUSSIA. See Abstract 336.

GENERAL BOTANY, BREEDING, ETC.

372. MADRAS: ANNUAL REPORTS OF THE AGRICULTURAL RESEARCH STATIONS, 1946-47. (Received 1950.) *Hagari.*—The breeding work on *herbaceum* and *hirsutum* cottons was continued along the same lines as in the previous year. The problem of the tract in the improvement of *herbaceum* cottons is mainly to improve the ginning percentage of H.1 cotton, grown practically throughout the entire locality. In addition an increase in fineness and yield level is sought. Hybridization between H.1 cotton and fine and high ginning types of Bombay cottons is therefore being carried out in order to isolate a type having the characters of high ginning, productivity, fineness and early maturity which can be grown under the conditions of precarious rainfall prevailing throughout the locality.

Trials of early *arboreum* types are also being carried out with a view to finding out the types suitable to grow in this tract in the late (north-east monsoon) season along with H.1 cotton. The *arboreum* selections have higher ginning percentage, strength and lower fibre weight than H.1, and what is required as a result of these trials is a type which, when sown in the late season, matures as early as H.1 and gives as much yield as H.1, if not more.

Nandyal.—Cotton yields at the Station have been high this year. The average yield of N.14 cotton in yield trials was 400 lb. per acre, while the N.14 seed nucleus plot of 2·30 acres gave an average yield of 349 lb. per acre. Fresh crosses have been made during the year with N.14 and ten other reputed types of low fibre weight in order to improve the fineness.

At the instance of the cotton specialist, eight *arboreum* strains (two from Koilpatti, five from Coimbatore and one from Adoni) which were known to possess high ginning and good lint length were obtained and sown in comparison with N.14 and Gadag in randomized blocks of six replications. Although the varietal differences were significant, none of them is significantly better than N.14. In view of their high ginning percentage and their encouraging yields, however, it was proposed to try them again next year.

Koilpatti.—Owing to sudden and excessively heavy rains during the hot weather, and to serious damage by grasshoppers, the average yield per acre was only 80 lb. as against an average farm yield of about 450 lb. per acre. In general, the quality of cotton was not very greatly affected. It is gratifying to note that in spite of such an adverse condition the new cotton strain 4706 fared very much better than K.1 and other strains. In the present breeding programme for cotton are included the improvement of quality which has been steadily deteriorating in K.1 (the existing strain under distribution throughout the tract), creating an adaptability to yield well under different environments of soil and season, the production of a type that will tide over, withstand or recover from the sheding effects of untimely rains, and the evolution of a strain resistant to the affections of *Rhizoctonia bataticola*.

Coimbatore.—Two hybrid varieties—viz., sub-strain Co.4/B-40 and 7682—belonging to the long-staple category exceeding 1 inch, were tested in the districts of Coimbatore, Salem and Tiruchirappalli in scattered observation plots. The response of the sub-strain under varying soils, seasons, rotations and treatments and against established standards like Co.2, Co.3, 4463 or 920 has been extremely encouraging and consistent with its behaviour during the past season. It affords a rare opportunity for the unification of the entire irrigated cambodia area under Co.4/B.40, which happens to be also the most popular strain now under cultivation in Masipattam area. Its spread as a cold-weather strain will effect a phenomenal change in the quality of cambodia produced in Coimbatore and Salem districts, profoundly alter the economic conditions of the cultivators on account of increased cash returns, and lessen the off-take of imported foreign varieties in local mills.

373. PLANTING DATE AND COTTON PRODUCTION IN THE BUGANDA PROVINCE OF UGANDA. By H. L. Manning. (*Emp. J. of Exper. Agric.*, **17**, 68, 1949, p. 245.) Food crops are of primary importance to the predominantly agricultural community of Buganda. They must be planted with the onset of the first rainy season, which over the greater part of the Province is more reliable than the second rainy season. Cotton may be planted during the period of low rainfall between the two rainy seasons, or with the onset of the second rains. Harvesting of cotton must take place before the onset of the next rainy season in March.

Previous trials conducted over several years indicated that May-sown cotton gave the highest yields. The validity of these results was questionable, since contiguous plots were used for the different planting dates; insect migration could have taken place from early- to later-sown cotton. A new type of sowing-date experiment indicated that there was no evidence that insect interference contributed to the lower yields of cotton sown in August and September. Rather, the cotton sown in May and June had the highest Lygus leaf-damage counts. The optimum sowing date for this trial was near May 1, but yield decline was not demonstrable before June 26.

Cumulative evidence from further independent trials confirms the evidence adduced from previous departmental trials; the optimum sowing date for the area nearest the equator occurs during the early part of June; farther north in Buganda dates as late as mid-July have also given high yields. Cotton sown about these dates enjoys the additional advantage derived from accumulated nitrate-nitrogen, immediately before the main flowering flush.

Provincial production confirms the experimental evidence. An advance in mean planting date from mid-August to late June or early July would lead to a large increase in production as long as acreages were not reduced. Also, although the specific optima would be impractical to attain, the contraction of the planting season would result in an average planting date nearer to these optima.

Advances from varietal improvements, which would include breeding for resistance to plant-diseases and insect pests, and the small percentage increments expected from applications of fertilizers, are relatively insignificant compared with production increases to be expected from advancing the planting-date and a contraction at both ends of the planting season.

374. RESPONSES OF COTTON TO 2, 4-D. By D. R. Ergle and A. A. Dunlap. (*Texas Agric. Expt. Sta. Bull.* 713, 1949.) Widespread use of the hormone weed-killer,

2,4-D (2,4-dichlorophenoxyacetic acid) has resulted in many cases of unforeseen injury to susceptible crops. In the case of cotton, unfavourable effects from drifting of the chemical have been reported. Experimental and observational evidence show that cotton is very sensitive to the 2,4-D compounds commonly used in weed-control work, and a greenhouse experiment was conducted at College Station during the winter 1948-49 to ascertain the exact effects of small quantities of 2,4-D on cotton.

Four groups of cotton plants in the prebloom stage were treated with sodium salt of 2,4-D equivalent to 0·002, 0·01, 0·02 and 0·04 milligram of 2,4-D acid, respectively, and the subsequent growth and chemical responses were studied. The principal results are summarized as follows:

Growth: Plant height and the number of main-stalk nodes increased in proportion to the amount of 2,4-D applied; in the case of the heaviest dose, the increase was 38 per cent. and 21 per cent. respectively. Also, the formation and growth of vegetative branches was stimulated by the two largest applications. The largest amount of 2,4-D, on the other hand, repressed development of fruiting branches; and injury to the main-stalk leaves, as reflected by reduction in leaf weight, was increased progressively from 27 per cent. (0·01 mg.) to 77 per cent. (0·04 mg.). The smallest amount of 2,4-D (0.002 mg.) produced no visible signs of leaf modification or injury.

Fruiting and fibre: Compared with untreated plants, the 0·02 and 0·04 mg. applications suppressed flower production 7 per cent. and 33 per cent. respectively, and reduced the number of bolls set per plant 12 per cent. and 53 per cent. respectively. Likewise the yields of seed cotton were reduced 20 per cent. and 58 per cent. respectively by these amounts. Only the results from the 0·04 mg. application were indicative of a trend which was toward a reduction in (*a*) fibre weight per inch, (*b*) percentage of mature fibre, and (*c*) tensile strength.

Leaf constituents: In the main-stalk leaves, the concentrations of sucrose, hemicellulose and cellulose tended to increase with increased amounts of 2,4-D applied. Varying with equal consistency, but inversely to the amount applied, were reducing sugars and total organic acids. Leaf starch appeared to be affected by only the heaviest dosage of 2,4-D.

(*Cf.* Abstract 356, Vol. XXVI of this Review.)

375. Étude des Qualités et des Méthodes de Multiplication des Nouvelles Varietes Cotonnières au Congo Belge. By M. Lecomte. (L'Institut National pour l'Étude Agronomique de Congo Belge, Brussels, Ser. Tech. 36, 1949. Price F. 40.) This report describes the experiment which led to the selection of the variety Stoneville for distribution throughout the Uele region of the Belgian Congo in the place of Triumph. Particulars of the methods of multiplication and selection are given and the report includes a description of the seed control and distribution system whereby it is hoped that the strain will be kept pure and will not suffer deterioration.

376. Complementary Factors for Dark-red Plant Colour in Upland Cotton. By B. L. Johnson. (*J. Agric. Res.*, 78, 11, 1949, p. 535.) The paper describes a dark-red plant colour which appeared in a stock of red Acala cotton of normal stature at Stoneville, Miss., and presents the results of studies which show that the inheritance of dark red may be interpreted in terms of the factor for *hirsutum* red and a factor for dwarf red.

377. Nuclear Changes in the Hair Primordial Cells of *Gossypium hirsutum*. By A. S. Heiba. (*Egyptian Cott. Gaz.*, 8, Sept., 1949.) It has usually been accepted that the lint and fuzz hairs are unicellular, uninuclear outgrowths of the seed coat epidermis. Recent Indian work on *G. arboreum* suggests, however, that lint hairs are tetraploid, resulting from the fusion of two diploid nuclei. In 1948 the author observed that two nuclei were rarely found in a lint hair of *G. hirsutum* and *G. barbadense*. The present study was carried out at the plant-breeding department of the University of Arizona, to follow the mechanism with which these two nuclei originate.

378. Variation in Length in the Hairs of One and the Same Seed of Cotton. By G. Roberty. (*Cot. et Fib. Trop.*, 4, 1949, p. 25. From *Pla. Bre. Ans.*, xix, 4, 1949, p. 839.) Statistical treatment has been applied to the problem of how best to determine the variation in the length of the hairs in a single seed of cotton. The method which is elaborated in detail has been used for seeds of varieties of *Gossypium* species and of interspecific hybrids. Points of special interest in the author's conclusions are: (1) in order to increase the homogeneity of cotton so as to reduce the loss in combing, almost spherical seeds should be the aim in selection, though this characteristic can also be considerably improved by cultural measures; (2) only closely related plants should be used in artificial hybridization; if an inter-sectional hybrid is desired it must be produced by successive steps, and selection of the parent plants for subsequent lines should always be based on a microscopic study of the homogeneity as regards fineness of the hairs; (3) as regards modal lengths such as are observed by the ordinary methods of measurement, selection must never be pressed beyond a certain limit, since the conditions of cultivation at an experimental station are particularly favourable, whereas in large-scale cultivation the mode will naturally regress towards the mean and all the more markedly the greater the difference between these two values.

379. MATURATION OF COTTON: ITS CONTROL AND IMPORTANCE. By M. O. Roehrich. (*Bull. de l'Institut Textile*, **17**, 1950, p. 9. From *Text. Tech. Digst.*, **7**, 4, 1950, p. 253.) In the light of recent work by Hutchinson, the author defines the cotton fibre as a naturally immature hair. The different methods of judging the degree of maturation are reviewed, and emphasis is placed on the concept of "thickness of wall coupled with width of band," and not considered separately. On the basis of work by Webb and Lord, the responsibility for defects is restricted to dead fibres; sub-maturation without too many dead fibres is only harmful to combed yarns. The possibility of obtaining high-maturation cotton plant strains is considered.

380. COTTON PLANT: EFFECT OF N, P, AND K NUTRIENTS ON LINT AND SEED PROPERTIES. By W. L. Nelson. (*Agron. J.*, **41**, 1949, p. 289. From *Summ. Curr. Lit.*, xxx, **7**, 1950, p. 173.) A marked increase in yield was obtained from the application of N and K on a very fine sandy loam; a smaller response was obtained from phosphates. N increased the boll weight and upper half mean length of fibres, but decreased the lint percentage and X-ray angle. P merely increased the size of the boll. K increased the boll weight, mean weight, fibre weight per inch, percentage of mature fibres, and X-ray angle, but decreased lint percentage and Pressley index. Top bolls gave lower values for boll weight, upper half mean, and mean length and higher values for lint percentage, fineness, and Pressley index. Applications of K reduced scutcher and card waste, lowered the number of neps, and slightly improved the grade of the yarn, but decreased the yarn strength. N applications increased the N content and reduced the oil content of cotton seed, but K reduced the N content and increased the oil content. The seeds from the top bolls were consistently poorer in oil.

381. A DISCRIMINANT FUNCTION FOR SELECTION OF YIELD IN COTTON. By V. G. Panse and S. A. Khargonker. (*Ind. Cott. Grwg. Rev.*, **3**, 4, 1949, p. 179.) In plant breeding, the selection of plants with a superior genotype through the observation of phenotypic performance is very difficult owing to the large environmental fluctuations. Fisher's discriminant function technique applied to plant selection by Fairfield Smith is examined in this paper for evolving a suitable discriminant function for use in selecting for yield in cotton plants. Results from two varietal trials and two progeny row trials on cotton (*G. arboreum*) were used for this purpose. Calculation of the genetic advance due to the use of the discriminant formula compared to straightforward selection on plant yield was made; but it was found that the discriminant formula gave very little extra improvement as compared to simple selection on yield. A similar result was obtained by comparing the correlation between the mean yield of the progeny with the yield of the parent plant or its discriminant score.

It is concluded that the discriminant function as studied in this experiment does not provide a method of making more efficient selection for yield than the plant yield itself. Attention of breeders is drawn to the suggestion that in so far as replicated progeny row trials are concerned, selection of plants should be made from all replications on the basis of deviations of individual plant values from the respective plot means.

FIBRES, YARNS, SPINNING, WEAVING, ETC.

382. COTTON FIBRES: ELASTICITY. By R. W. Asmussen and F. Anderson. ("Studies on the Elasticity of Cellulose Fibres—I," Contrib. Danish Inst. Text. Res., 3, 1947, p. 3. From *Summ. Curr. Lit.*, xxx, **6**, 1950, p. 150.) The mechanical properties of single American cotton fibres have been investigated at various moisture regains at 20°C. The first part of the paper gives a fairly full account of the apparatus and methods. The fibre is mounted between two clips, one of which is attached to a screw-head by which means the tension is applied, and the other is connected to a movable plate of a condenser. As the fibre stretches the capacity of the condenser is altered and this change is measured by a high-frequency arrangement and recorded by means of an oscillograph and a moving film strip. An electromagnetic arrangement enables the movable plate to be pulled back to its original position. By measuring the current (through the electromagnetic coil) which is required to bring the condenser plate to its initial position the tension in the fibre can be determined.

With this apparatus static and dynamic (fibre subject to longitudinal vibrations) stretch measurements can be made. Some elongation tension curves are shown. They are linear for single cotton fibres in air of various degrees of humidity, but the slope increases in water and decreases with increasing humidity. The results are discussed with respect to elasticity and viscosity of the fibre.

383. COTTON FIBRE: RELATIONSHIP OF MATURITY TO WAX CONTENT. By A. N. J. Heyn. (*Text. Res. J.*, **19**, 1949, p. 711. From *Summ. Curr. Lit.*, xxx, **4**, 1950, p. 88.) A new determination of the maturity of cotton is based on a wax analysis. It is shown theoretically and confirmed experimentally that "average maturity" is linearly related to the reciprocal wax content of the fibre. Tests on fibres of increasing age are reported and the results are compared for different varieties. The correlation between average maturity and percentage maturity (as determined by the conventional method) is illustrated.

384. FIBRES: X-RAY MICRORADIOGRAPHY. By C. H. Lindsley *et al.* (*Text. Res. J.*, **19**, 1949, p. 686. From *Summ. Curr. Lit.*, xxx, **4**, 1950, p. 88.) Soft X-rays can be used to form shadowgrams of single textile fibres, yarns and fabrics on fine grain photographic plates. The paper deals primarily with the microradiography of single fibres, and includes a description of experimental equipment, conditions under which necessary resolution is obtained, impregnation of fibres with substances to increase absorption of X-radiation, and examples of the utility of the method. Single cotton, rayon, wool and other fibres are clearly resolved by X-radiation generated at 5 kV.; at higher voltages (to 17 kV.) natural fibres give faint shadowgrams. When the fibres are impregnated with 10-20 per cent. lead sulphide or other materials, single treated fibres can be distinguished in masses of untreated fibres. This technique provides a possible means for tracing individual fibres through processing operations. Several photographs are reproduced showing some applications of the method.

385. MODERN BLOWING ROOM TECHNIQUE. By N. Pilkington. (*Text. Manfr.*, **75**, 1949, p. 577. From *Summ. Curr. Lit.*, xxx, **5**, 1950, p. 108.) The author discusses modern blowing-room practices for the production of good, clean, uniform laps. Single-process lappers are examined and the layout of such systems is illustrated diagrammatically. It is shown that good and economical results depend (among other things) on the correct use of air. Rates of working at each stage of the preliminary processing are considered and a graphical method of expressing these is shown. An electrical device for the accurate control of feeds at all stages is mentioned. Recent developments in blow-room equipment are briefly outlined and some general information on beaters is given.

386. CARDROOM DUST. (*Ambassador*, **11**, 1949, p. 132.) The problem of cardroom dust is reported to have been solved by the "Puremor" textile spray equipment. This apparatus is intended for the pre-conditioning of cotton and synthetic fibres. It is said to be operating successfully in about 280 mills in the United Kingdom and overseas. The advantages of this new system, which has been evolved by the

Manchester Oil Refinery Ltd., are said to include not only cleaner atmosphere and machines, but more compact droppings, wastes which do not give out clouds of dust on disturbance, more compact laps, and greater control of fibre in drafting, and generally improved processing characteristics. The system may be applied to rayon, jute, asbestos and other fibres.

387. DUST SUPPRESSION BY COTTON OILING. (*Cotton*, M/c., 18/3/50.) Shell Chemicals Limited announce that they are introducing a cotton-spraying oil, "Celconus A," and a spraying machine which together, it is claimed, represent a considerable advance over systems now in use. "Celconus A" is based on a highly refined mineral oil, and has no tendency towards oxidation or gumming. It readily forms stable emulsions with water and is sprayed in this form on to the cotton in the hopper feeder. In processing raw cotton, a maximum of 0·2 per cent. of the oil on the weight of cotton is required, and the cost per lb. of cotton treated is of the order of 0·015d.

Applied by means of the spraying machine, a film of "Celconus A" is spread evenly over each cotton fibre, and its use is claimed to give the following advantages: (1) Striking reduction in dust and fly, giving a much cleaner atmosphere in the blowing and carding rooms. (2) Cleaner machinery and buildings. (3) More compact wastes which are easily swept up without raising further dust. (4) Better drawing and spinning. (5) Prevention of deposition of wax on machine surfaces. (6) Reduction of static electricity during processing. Furthermore, when used at the concentration recommended, "Celconus A" causes no significant reduction in yarn strength.

388. TEXTILE MILLS: FIRE PREVENTION. By F. Bradbury. (*Text. Wkly.*, **44**, 1949, p. 1480. From *Summ. Curr. Lit.*, xxix, **24**, 1949, p. 485.) A report of a lecture and discussion on the causes of fires in cotton mills and their prevention. The grave risk due to fragments of metal in cotton going through opening machinery is stressed and mention is made of the "Greenwood" magnet for extracting iron, the "Cintel" electronic device for detecting metal, and the "Aztec" electrical fire detector and alarm system.

389. HEGEMAX: A REVOLUTION IN SPINNING. By E. G. Hegedus. (*Cotton Trade J.*, Int. Ed. 1949-50, p. 158. From *Text. Tech. Digst.*, 7, 2, 1950, p. 91.) In this article by the inventor of the Hegemax spinning technique, he describes the development of the processes, its features, and possible further developments. The Hegemax device is fitted in place of the ordinary thread guide; it consists of three discs, the largest being responsible for the drive of the rotating twist unit, the "turbine." The turbine gives a preliminary twist to the drafted sliver between the delivery rollers and the top of the balloon. The turbine has a slit through which the yarn is introduced when piecing up, and piecing up is actually effected while the turbine is running. Hegemax can be used on any standard make of frame. Some of the advantages mentioned include fewer breakages, higher spindle speed and 12 per cent. higher breaking strength.

390. EBONITE BOBBINS. (*Ambassador*, **11**, 1949, p. 133.) Losses and shortage of wooden bobbins recently led certain textile managers to approach United Ebonite and Lorival Ltd. in the hope that Lorival Plastics might be able to suggest a substitute for wood. After testing various materials, it was decided to use a special compound of ebonite. Several thousands of ebonite bobbins were moulded and have been tried out at a branch of the Fine Spinners and Doublers—the Musgrave Company, Atlas Mills, Bolton. It has been reported that the bobbins are successful in every way; 10,000 are recorded as having been in use for two years, and 20,000 for a year and a half, and of these not one has cracked, and there have been no losses because of ordinary cotton-spinning usage. The bobbins are made as a one-piece moulding, to very fine limits and accurate diameters, in a smoother, homogeneous hard rubber material; they have a very smooth inner lining, to which dust cannot cling, and they are said to run especially true, as well as being quiet in operation, thereby lessening noise in the mill-room.

Among advantages claimed for the bobbins are the elimination of mill-marks, absence of cracking or splintering, great shock resistance and no losses. They are also reported as not absorbing oil, and as there are no metal parts to chip off the danger of fire is greatly reduced. The bobbins are said to produce better spun yarn and to stand up to higher spindle speeds, which means that their use definitely results in increased output at lower costs. The smoothness of the surface is especially important in cotton and rayon spinning, in which any marks on the yarn may be caused by oil which has seeped into cracks on the wooden bobbin. It was originally feared that static electricity might present a problem, but the manufacturers have now declared that the risk is non-existent, because of the incorporation of a special conducting agent in the ebonite mix.

391. Cotton Yarn Structure. By J. Gregory. (*J. Text. Inst.*, **41**, 1/2, 1950, p. T1.) Part I (" Macro yarn structure ") of this series of papers on yarn structure demonstrates the need for exploring the general strength, weight, twist relationship for twisted yarn element, and the artificial yarn element tester described in Part II (" The Preparation and Strength Testing of Artificial Yarn Elements ") was devised for this purpose. The work described in Part III (" The Strength of Artificial Yarn Elements in Relation to Bulk and Twist ") is concerned with the analysis of data from tests made with the artificial yarn element tester on a limited number of cottons, covering the range normally encountered in spinning. No attempt is made in this paper to interpret the strength of the twisted yarn element in terms of properties other than those of its macro-structural features of weight per unit length and twist.

392. A Review of Literature on Neps. By J. F. Bogdan. (*Text. Indus.*, **114**, 1950, p. 98. From *Text. Tech. Digst.*, 7, 2, 1950, p. 85.) This review gives a summary of existing available knowledge on nep reduction, methods of sampling and extraction of nep, the effect of presence of neps and the cause of nep formation. Information is given on neps in ginning, opening and picking, carding, drawing, combing and spinning; nep reduction, and methods of sampling and expressing results. A bibliography of the literature on neps is also given.

393. Cotton Fabrics: Width and Length Contraction in Weaving. By J. H. Strong. (*Text. Merc. and Argus*, **122**, 1950, p. 270. From *Summ. Curr. Lit.*, xxx, **6**, 1950, p. 143.) The writer gives, with examples, six rules for calculating the allowance to be made for width contraction in weaving and eight rules for length contraction. Their limitations are discussed.

394. Lustre and Cotton. By G. S. Buck and F. A. McCord. (*Text. Resh. J.*, **19**, 1949, p. 715. From *Text. Tech. Digst.*, 7, 2, 1950, p. 145.) This is the second in a series of studies dealing with various qualities of cotton being prepared by the National Cotton Council of America. The report is divided into two parts: Part I consists of a survey of market prospects for lustre finishes on cotton fabrics and yarns, and includes sections on the size of the market and the influence of quality and price. Part II is devoted to technical aspects of lustre, and gives a comprehensive survey of the literature that includes 219 references.

TRADE, PRICES, NEW USES, ETC.

395.—Raw Cotton Supplies. (Ann. Rept. Fedn. of Master Cotton Spinners' Assens., 1949.) The report states that the Raw Cotton Commission has tried to supply spinners' requirements, but many occasions have arisen when the particular type of cotton required has not been available. Supplies of the higher grades of American cotton became particularly scarce towards the end of the year, and spinners have no guarantee that there will be a continuous supply even of any lower grade or growth which they may substitute.

Considerable fluctuations in cotton prices occurred during the year. As an example, between January and the devaluation of sterling in September, the prices of Egyptian long-staple cotton declined by over 10d. per lb. Following devaluation, the price of American has risen by 6d. per lb., while Ashmouni and Zagora have increased by 10d. per lb., though the Egyptian currency was devalued equally with sterling. These extreme fluctuations have all added to the spinners' difficulties in the conduct of business, especially as the changing prices have not been based on comparative world values.

396. RAW COTTON: PURCHASE AND DISTRIBUTION. By A. Bryce Muir. (*J. Text. Inst.*, **41**, 1950, p. 37.) Report of a lecture giving some aspects of the purchase and distribution of raw cotton in the United Kingdom. The pre-war trade, which was centred around the Liverpool Cotton Market, is reviewed. The cotton situation during the war is outlined, and the post-war development with the formation of the Cotton Commission are discussed briefly.

397. SPINNERS' COVER SCHEME. (*Cotton*, M/c., 20/5/50.) The Raw Cotton Commission has been examining with the Federation of Master Cotton Spinners' Associations what arrangements can most conveniently be made in advance to deal with any possible suspension of business by the Commission, such as might occur immediately following a revaluation of currency here or abroad or any other major emergency likely to affect the price or availability of cotton.

A memorandum setting forth the Commission's arrangements for dealing with such an emergency has been issued to spinners and buying brokers.

398. CLOTH PRODUCTION IN THE UNITED KINGDOM. (*Cotton*, M/c., 1/4/50.) The Cotton Board announce that the weaving section of the cotton industry reached its highest post-war level of output in the four weeks ended February 25. Total cotton cloth production for the four weeks was 167·02 million linear yards and total rayon and mixture cloths 53·80 million linear yards, making an aggregate of 220·82 million.

399. COTTON CLOTH: EXPORTS TO EAST AFRICA. (*E. Afr. and Rhod.*, 12/1/50.) Exports of British cotton cloth in East Africa has fallen by more than 13 million square yards in the last year. Shipments from other sources of supply have resulted in the large accumulation of stocks, and considerable quantities of textiles are shortly expected from India and Japan. British exports of cotton goods to the Belgian Congo have increased tenfold since pre-war days.

400. MARKET OUTLETS FOR COTTON IN SOME OF THE PRINCIPAL COTTON FABRICS. By W. J. Martin and J. H. McLure. (U.S.D.A., Prodtn. and Marktg. Admin., Cotton Branch, February, 1950.) More complete and precise information concerning the quantities and qualities of raw cotton required for the major types of cotton textile products has been needed for many years. Particularly is this true with respect to cotton producers and persons having responsibilities in the formulation and direction of agricultural programmes. This study was designed to show manufacturers' requirements and preferences, or more specifically to ascertain the quantities and qualities of raw cotton needed in the manufacture of each of the principal types of cotton fabric. The information given should be especially valuable to those concerned with the development of cotton improvement and marketing programmes. Cotton breeders, armed with more exact information as to mill requirements, would be aided in developing varieties adapted to specific end uses; while cotton producers would be assisted in selecting varieties for which dependable market outlets are available.

401. UREA-PHOSPHORIC ACID METHOD OF FLAMEPROOFING TEXTILES. By F. V. Davis *et al.* (*J. Text. Inst.*, **40**, 12, 1949, p. T839.) The treatment of cotton fabrics with mixtures of urea and phosphoric acid followed by a "curing" at a temperature of 130°-175°C. gives a flameproof finish which is resistant to hot-water washing and even to mild soap scouring. The efficiency of the flameproofing has been shown to depend on the phosphorus content of the treated material, and for complete flameproofing a minimum of 3 per cent. of phosphorus is necessary. This phosphorus is strongly bound by the cellulose and is not removed even by boiling 1 per cent. caustic soda. It is associated with nitrogen present as the ammonium radicle and easily removed as ammonia by alkali.

Cotton fabrics flameproofed by urea-phosphoric acid lose some of their flameproof properties on repeated washing with alkaline detergents, but the loss of flameproof property is not due to removal of phosphorus, and the original degree of flameproofing can be restored by an acid treatment.

402. COTTON'S FUTURE. By R. P. Dunn. (*Egyptian Cott. Gaz.*, **9**, 1950, p. 1.) In this article the author attempts to forecast the future of the cotton industry in the face of growing competition from synthetics and noticeable changes in demand. The indications are that world markets will need all the cotton which will probably be grown outside the United States under normal price relationships. It would appear, however, that these areas are unlikely to increase production more than 60 per cent. in the foreseeable future, which would leave a deficit of nearly 12 million bales in demands outside the United States.

403. "WEBRIL R": THE FIRST TRUE COTTON FELT. (*Ambassador*, **1**, 1950, p. 121.) A new felt, which is made entirely of cotton and held together without binding, has been reported as a discovery by the research staff of Kendall Mills, Walpole, Mass., U.S.A. This felt, which is said to be the first true felt made wholly of cotton, is called "Webril R," and simulates the fibre structure of wool and leather. This fabric is reported as being held together by an elaborate entangling process which eliminates the need for either weaving or spinning, and gives the felt strength and freedom from linting. "Webril R" is also said to be both soft and flexible. It is thought that this new material may be successfully used in the manufacture of artificial leather, and other applications may be for plastics, surgical dressings batteries and filters.

404. COTTON IN THE LINEN SUPPLY INDUSTRY. By F. A. McCord and J. A. McCrossan. (*Text. Tech. Digst.*, **7**, 4, 1950, p. 252.) A survey of the use of cotton and other materials in the linen supply industry was conducted in 1949 to determine opportunities for increasing cotton consumption through stronger sales programmes and research activities. This summary report of the survey findings was prepared for the use of the cotton industry, research groups, and other individuals or agencies interested in the consumption of cotton in the linen supply trade.

405. SHOCK-RESISTING PLASTIC MOULDING MATERIAL. (British Resin Products, *Engineer*, **188**, 1949, p. 157. From *Summ. Curr. Lit.*, xxix, **21**, 1949, p. 412.) Shock-resistance is imparted to "Rockits 3932," a new thermo-setting plastic moulding material, by using as filler a twisted yarn or cord spun from cotton of good absorptive properties. The right amount of twist in the cord is important; it gives strength to the individual filler particles and controls the resin absorption.

406. USE OF NON-WOVEN COTTON FABRICS FOR PLASTIC LAMINATIONS. (*Ind. Text. J.*, **60**, 32, 1949, p. 94. From *Text. Tech. Digst.*, **7**, 2, 1950, p. 126.) Recent experiments disclose that the use of non-woven fabrics in various plastic laminates presents greater possibilities; non-woven fabrics can be produced more speedily and at less cost than woven fabrics. As a result of these experiments it has been found that (1) the tensile strength of the web-base laminates increases with fibre length; (2) laminate strength increases with degree of fibre orientation; (3) flexural strength was not significantly affected by either staple length or degree of length; (4) moisture absorption, impact strength, and electrical properties are dependent on the type of resin and not the web; (5) cross-plying of web yields much higher tensile strength in both directions; (6) the lighter the web for a given number of plies the stronger the laminate; (7) staple length and orientation have little influence on moisture absorption and dimensional stability; (8) web-base laminates give impact strength equal to, or better than, fabric-based laminates.

407. IMITATION STRAW FABRIC. (*Amer. Wool. Cotton Reptr.*, **64**, 32, 1950. From *Text. Tech. Digst.*, **7**, 2, 50, p. 106.) Woven fabrics which formerly contained rattan or were of the cane type are being replaced by those made of synthetic fibres. An imitation straw fabric is analysed which is composed of plastic filaments (cotton basis) averaging about 30 denier in size. The filaments are both flat and round at different points regularly throughout their length, which gives the heavy yarn more flexibility. The resultant fabric has high strength, is comparatively stiff, and its weight is not very great.

408. CELLULOSE: SUBMICROSCOPIC STRUCTURE; INVESTIGATION BY NITROGEN SORPTION MEASUREMENTS. By C. M. Hunt *et al.* (*J. Res. Natl. Bureau Standards*, **43**, 1949, p. 547. From *Summ. Curr. Lit.*, xxx, **9**, 1950, p. 238.) A sample of cotton linters, swollen with strong alkali and given a solvent-exchange treatment, has been found to have a much greater surface area available to nitrogen than untreated material. Adsorption and desorption isotherms have been obtained showing strong hysteresis, and pore size distributions have been calculated. Alkali-treated samples, when conditioned with water vapour, show a progressive decrease in area. Cotton swollen with water only and given a solvent exchange treatment also shows an increased surface area.

409. COTTON CELLULOSE: CHAIN-LENGTH DISTRIBUTION. By H. A. Wannow and F. Thormann. (*Kolloid-Z.*, **112**, 1949, p. 94. From *Summ. Curr. Lit.*, xxx, 7, 1950, p. 194.) American Upland cotton was purified, bleached, degraded with alkaline hydrogen peroxide, and nitrated. The degraded nitrocellulose was dissolved in acetone and fractionally precipitated with water. Viscometric and osmometric measurements were made on the various fractions and the chain-length distribution was calculated. The chain lengths of the fractions were not distributed symmetrically with respect to the measured degree of polymerization of the sample—*i.e.*, the main portion was homogeneous with longer chain length and the remainder was heterogeneous with shorter chain lengths.

410. RAPID METHODS FOR DETERMINING THE CUPRAMMONIUM FLUIDITY OF COTTON CELLULOSE. By F. Howlett and D. Belward. (*J. Text. Inst.*, **40**, 1949, p. T.399.) In an attempt to shorten the time required to obtain fluidity results on cotton cellulose two modifications of the British Cotton Industry Research Association's experimental procedure are described. The first method consists in drying the cotton and then preparing from it a solution of exactly 0·5 per cent. concentration, a degradation inhibitor (pyrogallol) being added to the solvent, and in the second method a known weight of damp cotton is dissolved in cuprammonium, its moisture content is determined separately, and the relation between concentration and fluidity is used for conversion of the result to exactly 0·5 per cent. concentration (by means of a nomogram). Results are presented and compared with those obtained by the B.C.I.R.A. technique.

MISCELLANEOUS

411. COTTON: WORLD PRODUCTION, 1949-50. (Int. Cott. Adv. Comm., Monthly Rev., February, 1950.) The 1949-50 cotton harvests can still be counted upon to yield some 31,000,000 bales. In Africa, south of Egypt, crops on the whole seem likely to be somewhat smaller than in the preceding season, due chiefly to less favourable growing conditions in Uganda and Anglo-Egyptian Sudan. On the other hand, a universal increase in cotton crops is in prospect in South America.

The evidence to date indicates that world export availabilities of cotton in 1949-50 are substantially larger than in the preceding season. However, due to the depletion of stocks in almost every exporting country except the United States and the swing away from medium-staple cotton growing in Egypt, export availabilities of non-dollar medium-staple cottons are likely to be little, if any, larger and may be smaller than in 1948-49.

412. INTERNATIONAL COTTON BULLETIN. The *International Cotton Bulletin* made its first post-war appearance with the January issue for 1950 (vol. xviii, No. 69.) This quarterly publication, which is produced by the International Federation of Master Cotton Spinners' and Manufacturers' Associations, preserves all the features which formerly made it such a useful source of information for traders and others interested in cotton and cotton textiles. In includes reports on the state of trade in various countries, on cotton growing, mill activity, textile technology, etc., as well as reviews of current literature and a statistical section. The editor is Mr. N. S. Pearse, and the subscription is £1 7s. 6d. per annum.

413. SHIRLEY INSTITUTE YEARBOOK, 1949. (Manchester: British Cotton Industry Research Assen., 1949. Price: 5s.) This handbook gives a comprehensive report on the work now being carried out at the Institute, together with a survey of the historical background. It includes a description of the building, and gives details of the services available to members of the Association.

Printed in Great Britain by
Billing and Sons Ltd., Guildford and Esher

THE
EMPIRE COTTON GROWING
REVIEW

VOL. XXVII OCTOBER, 1950 No. 4

NATURAL SELECTION IN EGYPT'S COTTON CROP

BY

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IN the year 1926 it was made illegal to sow in Egypt any cotton seed which had not been inspected (in sample form) and certified fit for sowing.[1] This certificate included germination tests to guard against injury by the heat-treatment used for killing pink boll-worm, but it was primarily a guarantee of reasonable varietal purity. The only test then available for such purity was the appearance of the seed itself, so that the legislation was based on a partial fallacy, because the typical seed-coat of a variety can contain a hybrid embryo; also, there is some fluctuation in the appearance of the seed-coats borne on one and the same plant. However, the Egyptian crop in the Delta at that time was composed of only two principal varieties, Sakel with a rather fuzzy seed, and Zagora (Ashmouni), the seed of which was nearly naked; thus a sorting-out into typical and off-types was fairly dependable. In addition, there were small percentages of seed from the "Hindi weed," a different species, whose naked beaked seeds were easily recognizable; our discussion will be confined to this component.

The samples were collected by official sub-inspectors on application from the owner, and sent to central seed laboratories for examination. The standards of permitted percentages for off-types and for Hindi were announced at the start of each season, being fixed as high as would allow enough seed to be passed to meet the country's needs. This system drew in each year a true sample of the whole cotton-seed crop of Egypt, because it was found later that ordinary commercial seed chosen by its owner for sowing purposes was not noticeably different in genetic composition from that which was sent away for crushing into oil and cake.

Some of the data accumulated in working this seed-control law are utilized in the present note to demonstrate and measure the action of natural selection during the multiplication of varieties. For this purpose it is convenient first to confine attention to the occurrence of Hindi during the first seven years, from 1926 to 1933, when several uncontrolled seed stocks of commercial varieties were in existence. After 1933 these varieties had nearly all been supplanted by approximately pure lines included in the Giza Seed-Renewal System.[2] Subsequently it was shown by the late H. A. Hancock that natural selection in much finer shades was still measurable within such lines after they had been contaminated—as is practically inevitable in the long run—during their propagation, or even in the absence of such contamination if " unwanted genes " were present in the nucleus stock from which each individual line was renewed every year. We shall conclude with some excerpts from the data he obtained by using his own spinning-test technique for seed-control puposes between 1942 and 1946.

It should be noticed that the populations thus studied are enormous. Reckoning in round numbers on the low side, each year's facts are derived from the sowing of 3×10^{11} seeds, about one-sixth of which are left at thinning time to provide 30,000 plants on each of one and a half million acres. This total of seeds must, of course, be subdivided amongst several varieties each year, but even a minor variety provides data from some hundred million plants annually.

The significance of the data depends on the accuracy of the sampling, and it is fortunate that the statistics themselves showed evidence of false sampling in the early years, so that remedial measures were taken in time. No further legislation was needed; lists of suspect inspectorate staff, ginners and merchants were compiled from examination of the statistics in the form of a code known only to the writer.[3] Information that such lists existed was spread by unofficial rumour, and a few extra samples were drawn by Botanical Section officials in localities known to be dishonest. False sampling stopped at once.

The Occurrence and Characteristics of Hindi

The white-flowered Hindi weed-cotton is classified as *Gossypium hirsutum*, var. *punctatum*.[4] The source of this very different species within the Egyptian crop and the date of its first appearance are unknown. Fletcher[5] considered that it was represented amongst some of Todaro's specimens derived from Egypt in 1863. In 1905 it was stated by Foaden[6] that " the very best samples of Afifi contain 2 or 3 per cent. of Hindi," and he organized hand-sorting of seed to improve the supply from certain seed-producing estates. The introduction at that time of such new varieties[7] as Yannovitch, Abbassi, Nubari and Sakel, which necessarily started without any Hindi admixture, also helped to reduce the Hindi population, and by 1914 there was much less Hindi evident in the crop than there had been a decade earlier.

On returning to Egypt in 1927 after thirteen years' absence the writer noticed a great deterioration in the appearance of the cotton fields, which, except on the State Domains, were ragged with tall rogue plants.

The state of affairs was not as bad statistically as it looked, because only a few tall rogues are needed to make a field look very uneven, but the appearance of the crops was enough to explain the agitated protest which merchants had made in the previous year, when the new law had enacted 2 per cent. Hindi as the maximum permissible for any variety. In consequence of this protest the standard had been lowered to 4 per cent., quite needlessly, but before describing the changes produced by artificial selection during the next seven years in order to uncover the changes due to natural selection, we must examine three factors in the situation.

Hybridization.—Hindi and Egyptian can be crossed easily, but such crossing would seem to be surprisingly uncommon under field conditions. For instance, a population grown from a composite sample of Hindi seed collected during seed-control operations was found to be composed mainly of Hindi plants, with less than 20 per cent. of hybrids. Conversely, some Hindi hybrids would be grown from seed which is superficially Egyptian. Consequently seed selection can never eradicate Hindi hybrids from the crop, but the large proportion of uncrossed Hindi still existing after so many years of exposure to Egyptian pollen is probably explained by pollen prepotency.

The Hindi stock thus exists side by side with Egyptian, as if crossing were very rare. From Foaden's statement in 1905 to the beginning of seed control in 1926 covers twenty generations which had an average Hindi content of the order of 1 per cent. at least, and yet pure Hindi was still abundant in 1933. We shall not be seriously in error if we presently regard our statistics as representing a simple mixture.

The inheritance of the seed-coat characters is complex, even on the scanty evidence available, most of which is quoted by Harland.[8] The first cross may be full fuzz like Uplands, or semi-fuzz like Egyptians. The second generation may contain 25 per cent. naked Hindi, or smaller percentages down to less than 1 per cent.; it may also include full fuzz. Modifying factors evidently act on the allelomorphs.

Survival after Sowing.—The cultivator has often been advised to remove Hindi seedlings at thinning time. If this were done it would disturb the relation between composition at sowing and when harvesting. This point was carefully examined by C. H. Brown in a survey on the land of several peasant cultivators, who had planted seed containing 0·5 per cent. Hindi. Trained observers from the Botanical Section found 0·07 to 0·17 per cent. in the clumps of slightly etiolated seedlings just before thinning. Three weeks later the recognizable Hindis in the stand of plants, which were now in pairs, ranged from 0·25 to 0·45 per cent. A final examination when the plants were in flower, and therefore unmistakable, raised the figures to 0·54 and 0·66, including Hindi hybrids. The presence of the latter accounts for the excess above the 0·50 per cent. content of the seed sown.

Evidently the content was not reduced by any conscious selection, nor is it easy to distinguish young Hindi seedlings. When they are large enough to be recognizable with certainty it is not in peasant nature to uproot a half-grown plant which will add to the weight of his cotton production.

Seed Yield.—The main conclusions about natural selection had been extracted from the seed-control statistics before the writer realized that we possessed no shred of direct evidence to show that Hindi was more prolific than Egyptian, though the statistics were otherwise inexplicable.

A leisurely study with many chequer-plot comparisons in many localities for several seasons was impracticable and needless. A single set of chequers was laid out on the well-known land of the Giza farm, choosing a rather low-yielding field to give the usual country average, and Hindi was compared with the two heaviest yielding Egyptian varieties in twenty-five plots. The Hindi was again derived from a composite sample out of the seed-control laboratory. The five groups were:

Hindi.
Giza Seven.
Ashmouni.
Hindi—Giza Seven mixture, 50/50.
Hindi—Ashmouni mixture, 50/50.

The mixtures were used to test the possibility that the behaviour of Hindi in a homogeneous plot might be changed when it was sharing a " hole " with an Egyptian plant. Sowing and thinning of the mixture was done so as to leave one of each in each hole, almost exactly.

The flowering and bolling curves were of the same general form, but the amplitude of the Hindi curves was markedly less. The mixtures were simply intermediate, so that there was no proximity effect. In other words, Hindi is a lower yielder, not higher, when the yield is expressed as the number of bolls.

The number of bolls is, however, only one factor in fecundity. It is the number of viable seeds which matters, and the following further results show that Hindi has a marked superiority, consequent on its possession of a big boll and a very low ginning out-turn.

	Giza Seven	*Ashmouni*	*Hindi*
Weight of boll contents (grams)	1·58	2·00	2·72
Ginning out-turn (per cent.)	29·9	32·6	19·1
Yield per acre (pounds):			
Lint	425	477	310
Seed	995	988	1315
Egyptian/Hindi Seed (pounds)		991	1315
(ratio)		100	130

The result was neatly confirmed by the mixed-seed plots, whose seed crop was tested by counting in the usual way, thus giving the ratio in numbers instead of in weights. The difference is trivial, because the seed-weights are all much the same.

Hindi—Giza Seven mixture, 50/50, gave 54 per cent. Hindi
Hindi—Ashmouni mixture, 50/50, gave 62 per cent Hindi
Average: 58 per cent.

Egyptian/Hindi, seed (ratio)	100	138

The figures are so clear-cut and interlocking that there is no reason to expect any substantial modification from repetition of the experiment, and we may safely conclude that the seed-producing advantage of Hindi over the best-yielding Egyptian is of such an order that a small proportion of Hindi in a contaminated seed stock should double itself in a little more than two years, since 1·41 is the square root of two. Substituting the known lower yield of Sakel, the difference enlarges to a ratio of 100/200, and the doubling could happen in a single season.

REDUCTION OF HINDI BY ARTIFICIAL SELECTION

It is necessary to examine the way in which seed control reduced the Hindi content, before we can appreciate the data for Hindi's increase when it is not controlled.

Sakel in the Delta.—The composition of the Sakel variety is shown at three-year intervals in Fig. 1. It was not as bad in 1926 as the merchants had expected; a limit of 4 per cent. would not have rejected any seed, so the 2 per cent. limit was restored. There was a mode at 0·0 per cent. due to Hindi-free stocks derived from the State Domains, and another mode at 0·5 per cent.

Three years later there are only traces of 2·0 per cent. seed, and the main mode is much taller, but at 0·1 per cent.; the 0·0 per cent. supply from the previous years of Domains stock is changing as its spreads. There is a curious mode at 1·1 per cent. which provided the clue to false-sampling frauds, already mentioned.

After another three years, the frauds having stopped, this secondary mode has vanished, and the single mode at 0·1 per cent. has been raised so high that it includes more than half the total. Standards had been progressively stiffened each year, as portrayed in Fig. 4.

Ashmouni in Upper Egypt.—Three similar curves for the Ashmouni variety from Upper Egypt, including some grown in the Delta as "Zagora," are shown in Fig. 2.

They begin with a much bigger content than Sakel in 1926. We shall see later that this is a miniature example of Willis's "Age and Area" hypothesis;[9] Upper Egypt was planted originally from the pre-Afifi crop of Delta Ashmouni, but did not develop any important area under cotton until "basin conversion" operations after 1904. New strains of "Uppers" had been introduced after 1914, but without seed renewal or seed control until Giza Two started in 1927. So we find in 1926 a

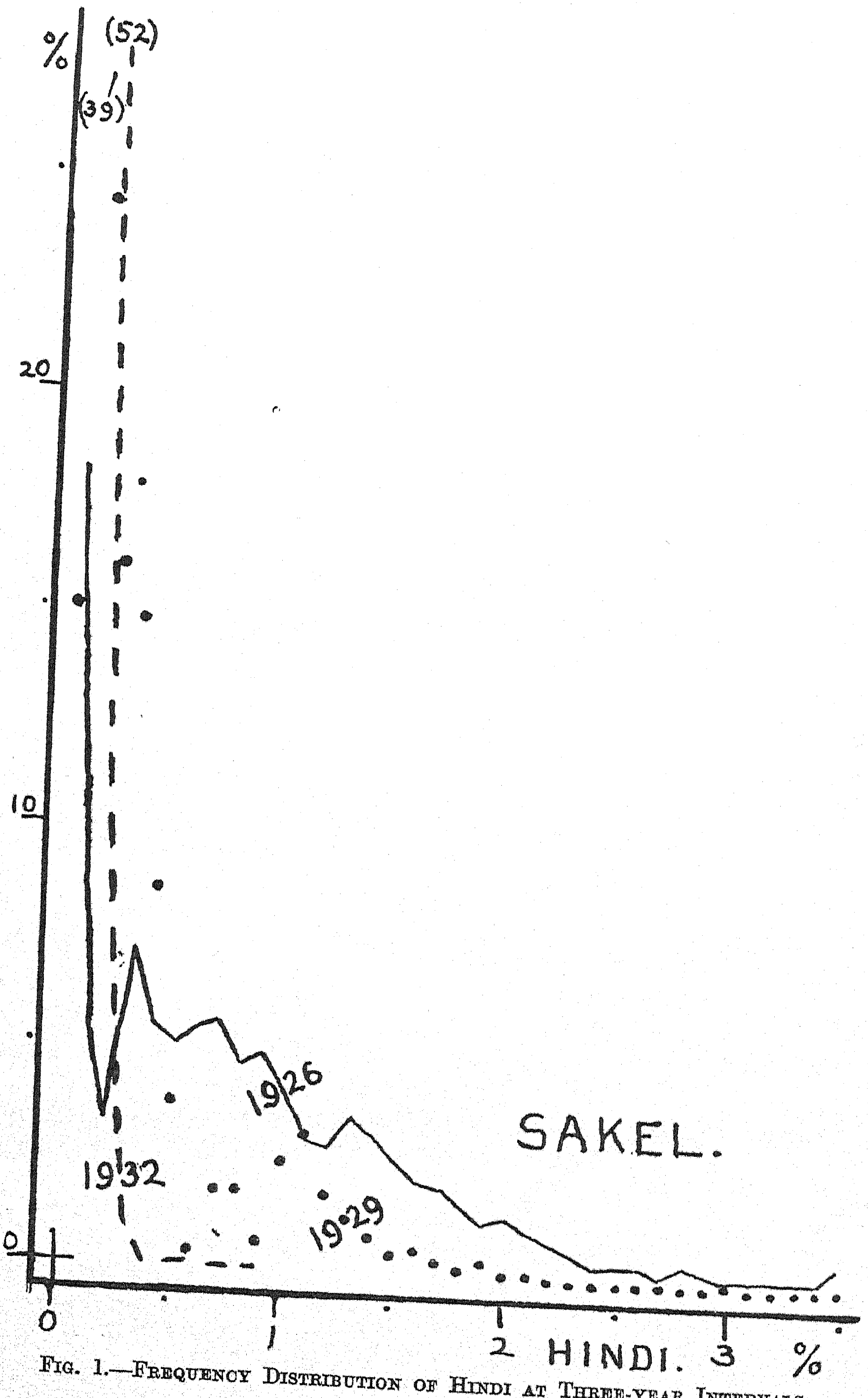

FIG. 1.—FREQUENCY DISTRIBUTION OF HINDI AT THREE-YEAR INTERVALS.

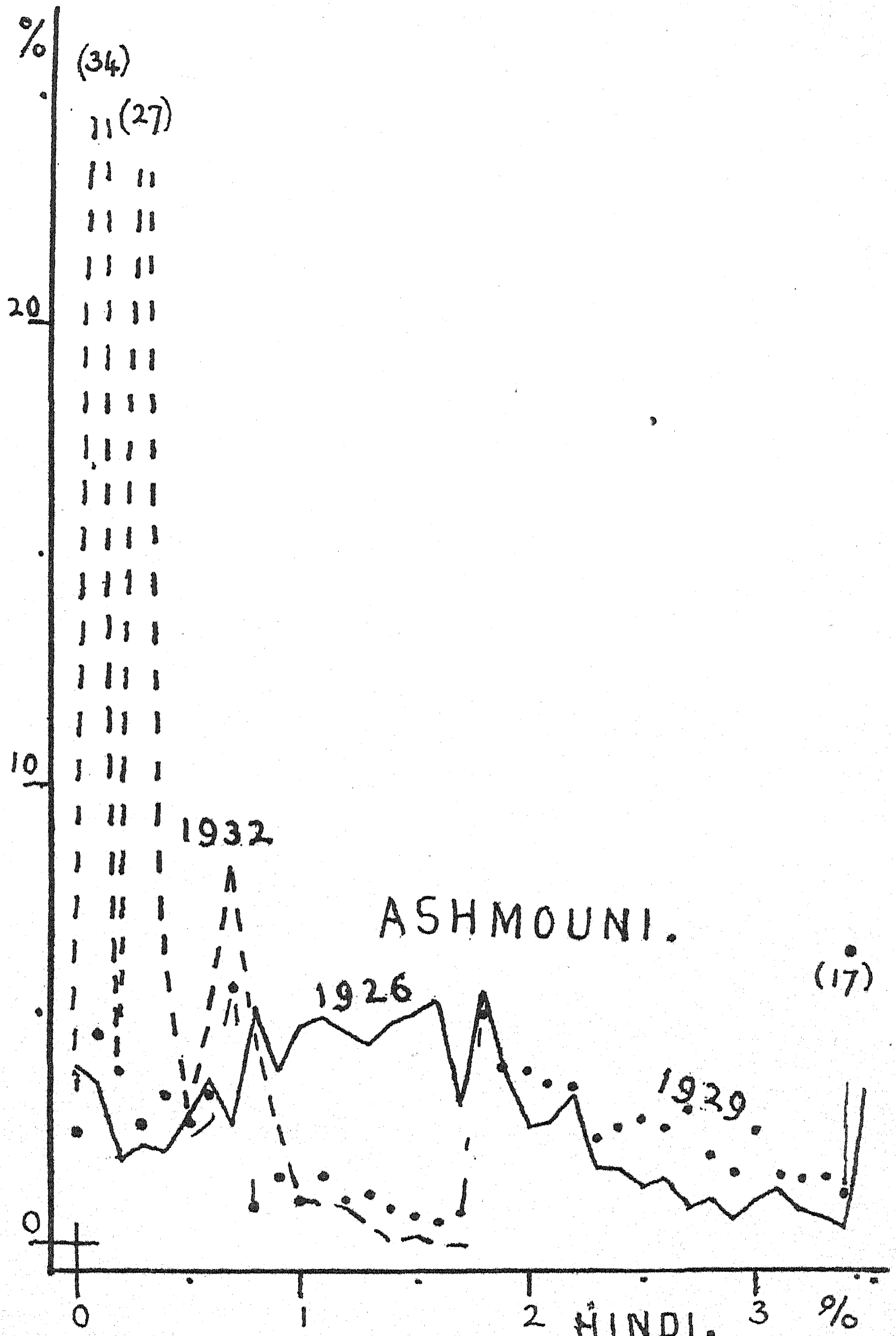

FIG. 2.—FREQUENCY DISTRIBUTION OF HINDI AT THREE-YEAR INTERVALS.

little 4·0 per cent., a mode at 1·5 per cent.—much worse than Sakel—and only a trifle of clean seed due to one or two estates which collaborated with the Government.

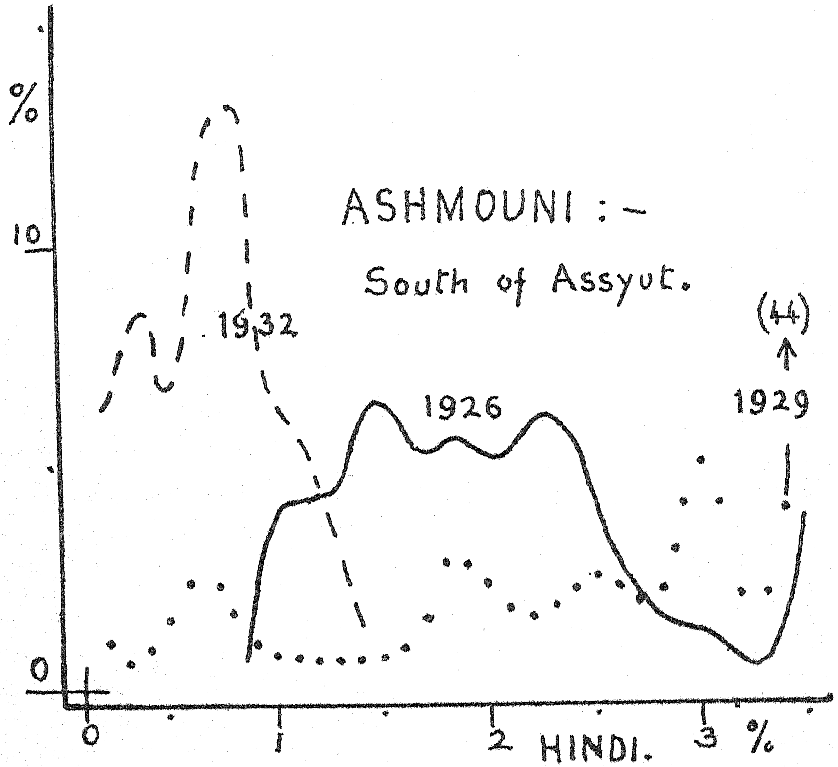

FIG. 3.—FREQUENCY DISTRIBUTION OF HINDI AT THREE-YEAR INTERVALS.

Three years later the position was fantastic. The curve had split in two, with a feeble improvement on the low-Hindi side, and very much worse conditions at the high end. The whole system of control looked futile. It was all but incredible that nearly half the inspectorate, ginners and merchants should have been driving coaches and four through the seed-control law by false sampling, but such was the case, for after this petty law-breaking had been stopped the curve for 1932 approximates, though belatedly, to that for the same year in Fig. 1.

The statistical evidence directed our attention particularly to the extreme south of Upper Egypt. Cotton was a comparatively new crop in this district, grown by pump-irrigation on basin land, a system which can carry heavy artificial manuring and produce very high yields. The three curves for this district are isolated from the data of Fig. 2, and plotted separately in Fig. 3; they are smoothed to three-point means because the figures are relatively scanty. In 1926 the district was much the same as the bulk of Ashmouni in Fig. 2. Three years of seed control made it very much worse; selection seemed to be acting in reverse. Actually, the worst sacks of seed were being provided with falsified certificates, so that a slightly better price could be pocketed for the best sacks in selling them for crushing. After another three years, fraud having been stopped, the normal shift to decreased Hindi content is found as with Sakel.

All varieties.—Similar frequency distributions for all varieties in each year are available, but it will be sufficient now to deal with the data in the form of average values for each year. The results plotted in Fig. 1 thus become three points only on a curve showing changes of Sakel content in Fig. 4.

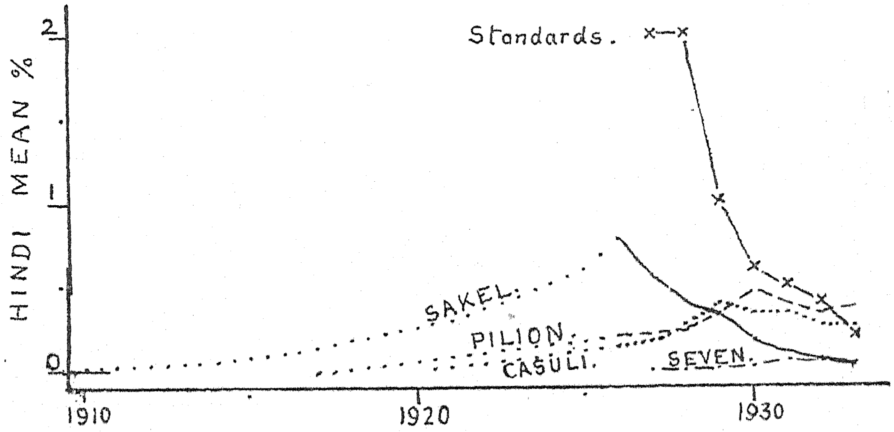

FIG. 4.—AVERAGE HINDI CONTENT OF DELTA VARIETIES.

Sakel started life about 1910, bred by Mr. Sakellaridis, and was then of course free from Hindi. Up to 1926 we can only conjecture its Hindi content by a dotted line. The 1927 crop was the first to be influenced by seed-control rejections, though only slightly, as we have already seen, but it shows an improvement on 1926 already. The fall continues slowly till 1929, being delayed by the frauds; then the fall is accelerated. The standards enforced on each season's crops in the previous year are shown by a line of crosses, and it will be noticed that this line appears more like a threat than a cause; the reason is that the Sakel stock was being continuously renewed (as "310" and later Sakha Seven) from the State Domains. The decreasing area of Sakel was making the Domains crop a progressively larger fraction of the total, so that more room was left to utilise all the Domains seed in replacing the contaminated seed which seed control had rejected.

Giza Seven was the first "pure line" cotton subjected to annual renewal from a nucleus stock, and not merely from bulk. The result is the same, though the history is much shorter; its six years of commercial handling show an increase in Hindi, but only a small amount came within the scope of rejection in 1933, under a standard which had stiffened to 0·1 per cent.

Pilion and Casuli may be considered together. Both were commercial introductions like all previous Egyptian varieties, whereof no original stock was preserved, and so no renewal system was possible. Pilion had been spread over fairly large areas since 1917, while Casuli was a special-market cotton which was given careful attention by its owner on quite small areas. Both show an increase, though they were considered commercially to be Hindi-free in 1926. By 1930 this increase had carried them above the improved condition of Sakel, and in 1933 they both cross over the standard limit. Unlike Sakel, where the threat was mitigated by Hindi-free renewal from the Domains, these had no clean supplies coming forward, and they ran straight into trouble. Pilion in 1933 suffered 80 per cent. of rejections, and by 1935 was extinct, as also was Casuli. The deterioration looked sudden and inexplicable to the commercial community, and yet it was merely the emergence to recognizable proportions of something which started soon after the first Pilion crop was grown.

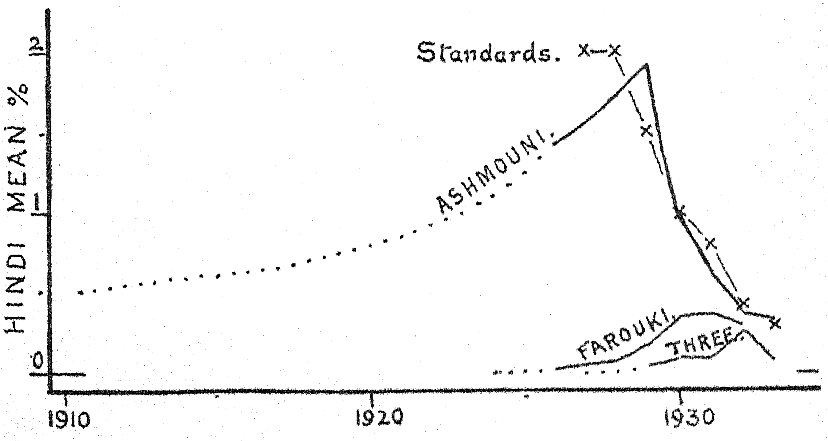

FIG. 5.—AVERAGE HINDI CONTENT OF UPPER EGYPT VARIETIES.

Ashmouni is similarly depicted in Fig. 5, along with two minor Upper Egyptian varieties. The effect of false sampling and its prevention is very clear, the content continuing to increase until 1929. If we extrapolate the curve, after allowing for a partial check during 1927 and 1928, it cannot be doubted that 1930 would have seen an average content around 4 per cent., and that odd lots might have reached 20 per cent. Evidently the seed-control law was started only just in time. After 1930 the curve drops as it did for Sakel, though it is belated.

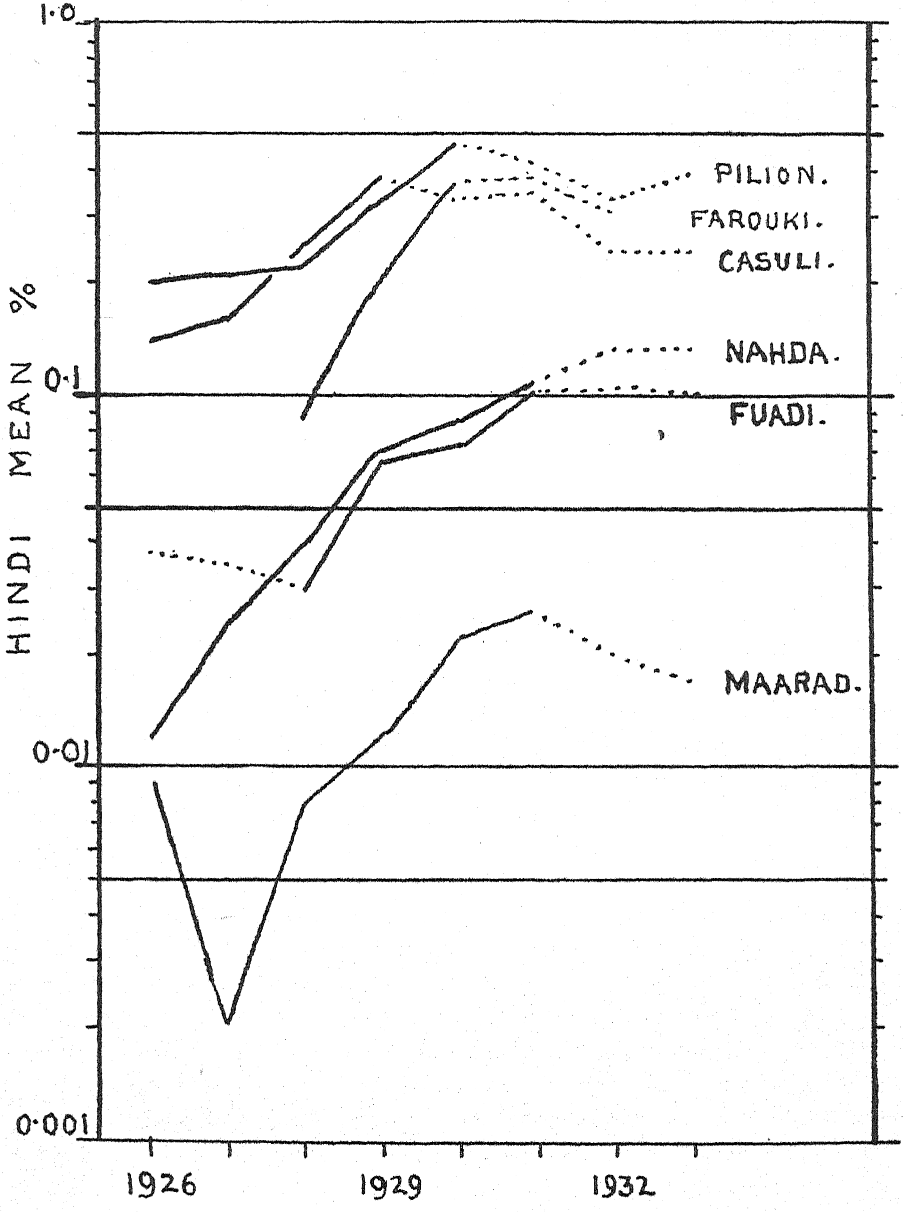

FIG. 6.—AVERAGE HINDI CONTENT OF COMMERCIAL VARIETIES.

Farouki is comparable with Pilion in the Delta. It necessarily picked up Hindi contamination more abundantly, because there was more in the crops of Ashmouni surrounding it. When only six years old it felt the effect of control, and as a ten-year-old it was extinct.

Giza Three was a renewal stock, and therefore should have resembled Giza Seven in Fig. 4, but here again we are dealing with fraud, though of a different kind; substitution took place, because the seed was indistinguishable from that of Ashmouni. As the strain was not important it was withdrawn from circulation.

Maarad, Fuadi, and Nahda appear in the next figures.

THE NATURAL SELECTION OF HINDI WITHIN EGYPTIAN POPULATIONS

The same curves for average yearly content of Hindi are re-drawn in Fig. 6 on a more open scale, omitting the varieties derived from renewal stocks, and including Nahda, Maarad and Fuadi. The later years for Pilion, Casuli and Farouki, when their composition is influenced by seed control, are indicated only by dotted lines, as also are two periods during which Fuadi was subject to some commercial control.

The remainder of the curves show certain similarities in form, but differences in amplitude, which are emphasized by the use of semi-logarithmic paper, so that a uniform percentage increase would appear as a straight line, the slope thereof depending on the percentage rate.

Such plotting shows a tendency to similar rates of increase in all varieties, the similarity being quite independent of the absolute content. The slopes vary a little between the Delta and Upper Egypt, but the slowest rate of increase shows a doubling of Hindi content within 2·0 years, and the fastest rate doubles in 1·1 years. Even Maarad shows similar rates, though this variety was supervised by its sponsors, the Royal Agricultural Society, with most exceptional care, but without renewal from a nucleus.

Thus it is clear that the amount of Hindi increases steadily in all stages of propagation, in all varieties which are not controlled by seed-renewal. It was formerly thought that this was due to admixture in the fields, at ginneries, or in stores, but the minor neighbours of Sakel in the Delta build up to higher contents than Sakel itself. Therefore we conclude that we must be watching a natural increase, due to the greater fecundity of Hindi. Also, we have calculated the rate of such increase to be the same whether our data come from seed-control statistics or from the direct field experiment already described.

The principal inference of practical use is this, that the age of a variety can be measured by its Hindi content. Disturbing factors can affect this calculation by a year or two, such as the amount of initial contamination, artificial selection, mixture, or fraud, but Fig. 6 shows it to be surprisingly dependable.

This in its turn alters our outlook on the part played by Hindi in seed control. After 1926 it served as an index to seed composition and (especially in Sakel) as a guide in cutting away the worst stocks, leaving room for the better ones. By 1933 it had become so rare as to be less convenient for that purpose, because many more seeds had to be counted, but more valuable because its presence detected stocks which had gone too many generations away from their nucleus source without renewal. Actually, the same object can be achieved, as was suggested by Hancock,[10] if the seed supplied to the grower is not merely marked with its varietal name, but also with the date of its triennial renewal from the foundation of nucleolus stock. Self-interest would lead any buyer to obtain " Karnak, 1949 " in preference to " Karnak, 1946." This " dated-seed system " was provisionally adopted in 1946.

The index value of the last traces of Hindi in the Egyptian crop is automatic, however, and not dependent on legislation, so Hindi may be worth preserving for its own sake, especially as it is doubtful whether a spinner could detect the presence of as much as 5 per cent. of it in his mixings.

NATURAL SELECTION OF LOW QUALITY WITHIN EGYPTIAN POPULATIONS

The pruning-knife of seed-control had made the cotton fields of Egypt look very different by 1935. Throughout the Delta they presented a level surface of well-bred monotony, instead of the ragged and jungly appearance of 1927. It was tempting to think that enough had been done, because the annual multiplication of renewal stocks organized for all the new Giza varieties must surely drive out their own older and poorer seed. In general this was true; supplies controlled by Government were grown on about one-tenth of the area devoted to each variety, so that only two generations more would plant the whole country. In theory the next generation after that would disappear into the oil and cake mills as rejections from seed control. In practice there were exceptions.

The writer has an outmoded preference for preserving the liberty of the subject, and an objection to legislating for any purpose which can be attained by enlightened self-interest. So the system was left to work itself, seed supply growing up from seed renewal, and pruned away by seed control.

Presently it became apparent that although the nucleus stocks of the new varieties maintained their quality, and that this fell off only slightly during propagation on the Government-controlled area, yet there was an appreciable amount of deterioration in the commercial crops descended from these areas. Seed which must have been much more than two generations removed from them was escaping the pruning-knife, although there was now no indication of any false sampling. Sakel was the worst, but Giza Seven was also inculpated, and signs of similar trouble were detectable in other strains.

Natural selection of inferior quality had not been effectively avoided by seed renewal, after all. Moreover, the defects of seed control by mere inspection of the seed, though always acknowledged to exist, were becoming serious now that the crops and their seed looked so good and uniform. Further, our " pure lines " could stand further purification; this was already known from such experience as Fahmy's isolation of different kinds of wilt resistance within Sakha Four. They seemed to remain pure in the small populations of the nucleus stocks, but field crops meant populations of hundreds of millions of plants.

Exact definition of the situation, with diagnosis, and the complete remedy, was provided by H. A. Hancock. He used the technique of the spinning test, which he had developed and refined until it became comparable with the triode valve or the electron microscope as an advance in the equipment of our investigations. His account is fortunately preserved in the last of his published papers,[11] but this appeared in a non-biological journal, and it may be useful to re-state the essentials of the evidence there presented, as it appeared in his original progress reports.

In January, 1942, he wrote: " It is clear that in the spinning test we have a powerful new instrument for the maintenance of seed purity," and he considered " the possibility of replacing or supplementing seed examination by spinning tests in the operation of the seed-control law." The trials were begun on the crop of the previous year, using only the high-quality cottons—namely Malaki (Giza 26), Karnak (Giza 29), Sakha Four and Sakel (Sakha 7). A portion of the available equipment was set aside for the purpose, sufficient to " test nearly a thousand samples in the season without serious delay to our usual work."

A year later he reported that the low-quality lots had been picked out correctly, and that classification by the district of origin—province by province—showed little variation. Seed from the 1942 classifications was also sown in 1943 and the offspring tested similarly with the same result. He noted that " the widening difference between Accepted and Refused Sakel, and Malaki, in 1943 (compared with 1942) perhaps reflects fast-expanding contamination in the Refused lots "; *e.g.*, for Sakel, in 1942 as 100/91, but in 1943 as 100/87, were the strength ratios of Accepted/Refused.

The genetic variance of the test results was separated out from variance due to environment and to spinning. It was less than 1·5 per cent. for Karnak and 1·5 per cent. for Malaki, but was 4·3 per cent. for Sakel.

By 1943-4 the new method was in full routine operation for seed control of the fine varieties. Comparisons of offspring from the previous year's classification were again made. " Not much impurity was found in Karnak, and only about 3 per cent. was refused, but the testing had some reality, since the Refused lots are slightly weaker than the Accepted. In Malaki quite appreciable deterioration is found, and the Refused lots are about 6 per cent. weaker than the Accepted. In consequence of the elimination of these weak lots the Commercial Malaki is now restored almost to the level of Ministry of Agriculture seed, below which it has consistently fallen since 1940." The next year he refused (at a strength of 2755) only 4 per cent. of all the Karnak crop, which was by then almost the only variety grown in the Delta, "so that the Karnak Accepted (at 2859) is right up to the value of the renewal nucleus."

We described his contribution as "a complete remedy," which may sound hyperbolical but is not. The cotton crop is grown to be spun, and the spinning properties of varietal seed are almost exactly reproduced by the offspring in normal cultivation. If the bad-spinning lots are eliminated in seed control, the spinner gets what he wants. The enormously complicated genetics which underlie this result are not the spinners' concern, but Hancock was using his evidence from spinning to locate and study the "unwanted genes" until the end.

SPINNING-TEST STRENGTH OF RANDOM SAMPLES DRAWN FROM SEED CONTROL.
Crops of 1941

Forty-seven lots of SAKEL

D=Domains seed

			2400					
			2405					
			2410					
		2300	2425					
		2305	2430					
		2315	2430					
		2325	2430					
		2330	2460	2505				
	2265	2330	2465	2520				
	2275	2350	2475	2525				
	2275	2360	2485	2535				
	2280	2370	2490	2550				
	2285	2370	2490	2550				
	2285	2390	2495	2590		2700		
....	2290	2395	2495	2595	....	2715	2880	**2920D**

Fifty-one lots of MALAKI

D=Domains seed
N=Renewal Nucleus seed

								2910		
								2910		
								2925		
								2935		
								2940		
								2940	3005	
								2945	3010	
								2955	3010	
							2825	2960	3015	
							2840	2960	3020	
							2860	2965	3025	
							2870	2965	3025	
							2870	2970	3030	
							2880	2970	3030	
							2880	2975	3045	
							2880	2980	**3045D**	
						2770	2880	2985	3050	3110
						2775	2885	2985	3055	3110
....	....	....	....	....	....	2795	2885	2990	**3060D**	**3120N**

FIG. 7.

(Reproduced from H. A. Hancock.[11])

Two graphs reproduced from his published paper illustrate the size of the trouble which he uncovered, and the delicate precision of his technique (Fig. 7). They show the yarn strength from plots, each of which was sown with a single lot of seed as received for examination under the seed-control law. Such seed was thus taken at random from Egypt's commercial seed supply of each variety. The original seed came from the 1941 crop, sown in 1942 and spun in 1942-3. Controls of nucleus seed for Malaki and pedigree seed for both Malaki and Sakel were included. All plots were duplicated. The actual yarn strength obtained from each sample is entered on the ordinates, to emphasize the fact that the best seed was actually the best.

The deterioration of the Sakel which had looked so uniform in the field crop is quite astonishing. The worst sample had a strength of 2265 instead of 2920; not much better than Ashmouni. In spite of all botanical precautions the bulk of the Sakel crop had gone to pieces, and only 3 in 47 were fit to accept in seed control; yet 46 out of the 47 had passed muster in the parallel examination of the seed itself.

The four worst Sakels were then grown on in 1943 so that they could be compared with the best for their appearance and behaviour in the field. The plots were exactly alike to the eyes of skilled observers, and no plant showed any trace of being a rogue. The seed fuzz was the same, seed weight was 7 per cent. low, hair weight 12 per cent. up, staple length 14 per cent. down, and yarn strength, as the graph shows, had fallen by 23 per cent. The inference is clear, that seed control had passed beyond the competence of botanical technique.

Malaki and Karnak gave similar results, with some seed difference, but Giza Seven off-types were recognizably different-looking plants. The point is interesting because this last variety was found to have been contaminated with foreign genes by natural crossing within the nucleus stock, through one season's neglect, whereas in the case of the other three the "unwanted genes" would seem to have emerged from the stock during propagation.

The processes of natural selection which cause these segregated off-types to multiply are more complex than the simple case which we have followed up with Hindi. The reader is referred to Hancock's last paper for his discussion of the genetic problem, and for some quotations from his data on the yield of the rogues, but the crucial practical result is evidently that Spinning-test Control is a complete preventive of quality deterioration within a Seed-renewal System.

During the period under review the seed-control laboratory was organized by Mr. A. K. Bedevian. The records were computed by Mr. A. Weinstein.

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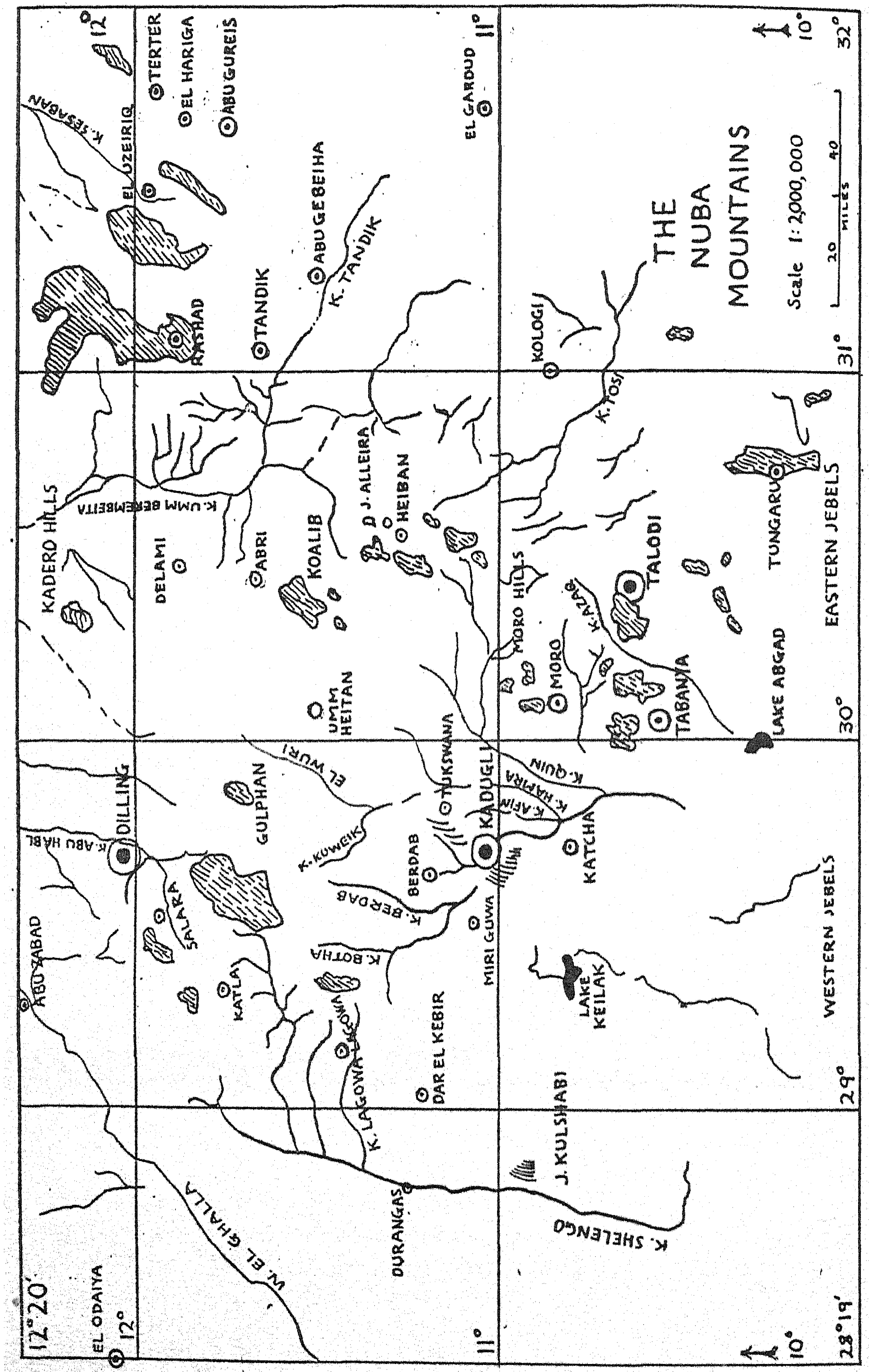
Received June, 1950


THE NUBA MOUNTAINS
Scale 1: 2,000,000
20
40
MILES
12° 20'
12°
11°
10°
28° 19'
29°
30°
31°
32°
EL ODAIYA
ABU ZABAD
K. ABU HABL
DILLING
SALARA
KATLA
GULPHAN
EL WURI
K. KUWEIK
K. BERDAB
BERDAB
K. BOTHA
LAGOWA
K. LAGOWA
DAR EL KEBIR
MIRI GUWA
KADUGLI
TUKSWANA
K. AFIN
K. HAMRA
K. QUIN
KATCHA
LAKE KEILAK
J. KULSHABI
K. SHELENGO
DURANGAS
W. EL GHALLA
WESTERN JEBELS
KADERO HILLS
K. UMM BEREMBEITA
DELAMI
ABRI
KOALIB
UMM HEITAN
D J. ALLEIRA
HEIBAN
MORO HILLS
MORO
K. ALAB
TALODI
TABANYA
LAKE ABGAD
TUNGARU
EASTERN JEBELS
K. TOSI
KOLOGI
EL GARDUD
RASHAD
TANDIK
K. TANDIK
ABU GEBEIHA
EL UZEIRIQ
K. SESABAN
TERTER
EL HARIGA
ABU GUREIS

POSSIBLE CROPS FOR THE COTTON ROTATION IN THE SOUTHERN JEBELS AREA OF KORDOFAN, A.E. SUDAN

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SUBJECT OF DISCUSSION

THE opening up of new roads and the development of an extensive programme of digging pits for water retention, locally known as *hafirs*, in the Nuba Mountains are doubtless the prelude to the exploitation of those vast clay plains which lie between the Eastern and Western Jebel ranges and to their east and west respectively. It is not difficult to anticipate a future emigration from urban areas and the formation of semi-settled communities on these plains in the vicinity of the *hafirs*. With the *hafir* as a centre of agricultural and social activity, density of population will tend to increase and the situation may well arise, not unknown to administrators and agriculturists in other parts of Africa, of overstocking, continuous cropping or shortened rotations. Under present-day conditions the agricultural system is extensive and soil regeneration is effected by the *harig* practice, described later, which is the equivalent of shifting cultivation. Under a more stable economy in which agriculture is confined to specific areas it is essential to recognize the necessity of an organized rotation, backed by adequate anti-erosion measures. Some data on the value of certain rotations for the area are available, but information is sketchy on the seasonal sequence of planting dates of those crops best fitted to a local cotton rotation. Such crops have been listed and discussed in this paper and an attempt has been made to integrate their sowing dates with that of cotton, namely in late June to early July.

The sequence of crops is roughly food, cash (cotton), oil and restorative. No attempt is made to deal with specialized crops found in isolated pockets throughout the area; the crops here discussed are the *field* crops of the clay plains.

AREA

The Nuba Mountains area, comprising the Eastern and Western Jebels, has been the subject of a comprehensive survey by Colvin,[1] and the limits of the rain-fed cotton crop in that region have been broadly outlined by Rose.[2] The area of particular interest covered by the present paper is the Dilling-Kadugli-Talodi triangle, lying roughly between latitudes 12° N. and 10° 40′ N.; however, such findings as are here recorded can be applied with equal emphasis to the clay plains lying to the east and west of this triangle and bounded by the same degrees of latitude.

Rainfall, which is sketchy and unpredictable in the north, increases on the journey south, with Dilling, Kadugli and Talodi returning a mean figure (26 years) of 679, 759 and 814 mm. respectively. Although light showers may be experienced in March, the rains normally break in April. In the northern section (Dilling and Kadugli) the rainfall can generally be divided into two distinct phases known as the little and the main *kharif*. The length of the break between the two can determine the fate of most early-sown crops, with cotton the most susceptible to such conditions.* Semi-drought conditions are usually relieved by the commencement of the main *kharif* in late June to early July, from which date a reasonable sequence of rains can be expected till the end of September. Toward the south and the heavier rainfall zone the two phases tend to merge into one of continuous rainfall. Throughout the whole area the rains finish abruptly at the end of October, and from that date, under the desiccating influence of a fierce sun, the standing crop has to depend entirely on subsoil moisture. The soil is an alkaline clay, grey-black in colour, with a clay fraction ranging from 40 to 70 per cent.; during the rains it has the consistency of a tenacious batter, in the dry season that of concrete. During the latter period the surface is marked by a reticulation of wide cracks extending downwards to a depth of 6-7 ft. This does not indicate the limit of the clay profile, which in some cases reaches to a depth of 18 ft. Mean maximum and minimum temperatures (°F.) recorded at Kadugli for the years 1935-9 are given below.

Growth Period (June to October).		*Resting Period (November to May).*	
Mean Maximum.	*Mean Minimum (°F.).*	*Mean Maximum.*	*Mean Minimum (°F.).*
91°	69°	97°	67°

During the rains the prospect is not unattractive. On the hillsides the genus *Combretum* is widespread, growing in close association with *Bauhinea reticulata*; on rocky outcrops and krantzes *Sterculia tomentosa* is found, with colonies of *Boswellia papyrifera* on the scree land at lower levels; where the granite masses merge with the plain the gaunt outlines of the " baobab " (*Adansonia digitata*) are unmistakable. The vast plains sweeping away from the granite foothills are lush with strong-growing grasses (see *harig* grasses), with *Balanites ægyptiaca* and *Acacia Seyal* marking the more fertile areas and the graceful *Anogeissus Schimperi* the seasonal watercourses.

During the dry period the scene is one of extreme desiccation.

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* Monthly *totals* give little indication of this hiatus, usually experienced in June.

AGRICULTURAL BACKGROUND

Throughout the area the agricultural system is primitive. Except for ox-drawn ploughs on experimental farms, mechanical implements are unknown. All operations are manual and the long-handled sowing hoe, the short-handled sowing hoe and the iron-headed cultivation hoe are the sum total of farming implements at the disposal of the cultivator. The winnowing of the grain crop, usually performed by women, is reserved for windy days; grain, glumes and rubbish from the sun-baked threshing floors are packed into baskets, placed on the head and tipped gently into a cross-breeze.

Organized rotations are ignored: the cropping of any piece of land is haphazard and follows the whim of the cultivator. Continuous cropping (either to cotton or dura) is the rule rather than the exception, and this expedient is followed until the area is farmed out. At this stage the land is abandoned and allowed to revert to a natural cover of strong-growing *harig* grasses. In three to four years when soil regeneration has taken place the cultivator returns, burns off the cover of grasses and recommences his system of exploitation. On occasions a two-course rotation (cotton—dura) is encountered, but in every case soil regeneration is effected in a few years by *harig* practice. Compost and artificials find no place in the agricultural economy, though the grazing of stock on crop residues at the end of the season may mean some return of humus and nutrients to the soil.

The cultivator is shrewdly aware of the intrinsic value of each crop, and regards with suspicion any introduction. His failing is not in *what* to plant but *when* to plant. Thus cotton may be planted as early as May or as late as September in an area whose effective growing period is 5½ months: both dates doom the crop to failure at the outset. This inherent casualness is largely responsible for the low average returns from all crops.

The crops at his disposal will now be listed and discussed. For the sake of convenience they have been placed in the three broad categories food, cash and restorative, although such an arrangement can lead to much overlapping.*

FOOD CROPS: GRAIN

(*a*) *Dura*

Dura (*Sorghum vulgare*) is the staple food crop of the area and in general importance overshadows all other crops. In the 1937-8 season the production of grain from the Nuba Mountains was estimated at 118,752 short tons. A very wide range of types is at the disposal of the cultivator, sufficient to meet all present-day requirements. Such types have been sorted and tested by Evelyn,[3] and their more general characteristics have been described by Rose[4] in an agricultural key.

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* Thus cowpeas (*Vigna unguiculata*) can fulfil all three requirements in any one season.

In the past the cultivator has been biased in favour of late mid-season to late types, and it is only through propaganda and field demonstration that he has become convinced of the importance of the earlies. Late types such as Galb El Jackus, Makoi and Kurgi with maturation periods ranging from 155 to 168 days give strong, vigorous growth in the early stages of development and with a good sequence of rains return high yields. In a late season, however, and when the October rains have closed down early, these types have little chance of reaching maturity and in many cases complete crop failure is experienced. On the other hand, early types such as Tahas 85, Fanda, Imsak Maratak and Birgalli Ahmar with maturation periods of 100 to 108 days are independent of good late rains, and when planted from mid- to late June can bridge the "scarcity gap" of August and September. This period is marked by a general shortage of all grain in which the local price of dura has risen on occasions to 60 P.T. per keila (approximately 12s. per quarter). Early types early planted are an essential requirement of the area; they can save the cultivator from exploitation at the hands of the merchants (in many cases the prospective cotton crop is mortgaged against a meagre supply of grain) and can relieve him of his dependence on the October rainfall.

One point of interest arising from the cultivator's preference of late types is his claim that they store better and are more resistant to grain pests than the earlies. Under experimental conditions, when the crop has been thoroughly dried out before threshing, no such difference in storing capacity has been noted. It can probably be related to the different set of conditions under which the two crops are harvested; the earlies are harvested toward the end of the rainy season, whereas the lates are allowed to mature and dry out in the field under conditions of intense heat and a rapidly falling humidity (November and December). In the latter case a lower moisture content at time of storage rather than any inherent quality of grain offers a feasible explanation for any such difference.

The duras are extremely well adapted to the harsh local conditions. They are hardy, drought-resistant and can survive the semi-dry period so often experienced between the little and the main *kharif*. Under conditions which would scorch up the young cotton seedlings, dura can survive and maintain itself on scattered showers until the arrival of the main rains; it can tolerate intense *Striga hermonthica* attack and will give good yields where maize would succumb before the cobbing stage.

In terms of labour distribution, dura can be planted with advantage before cotton, at any time from the middle of June. Exceptional seasons excluded, there are no grounds for the claim that the planting dates are conflicting; early and mid-season types, early planted (mid- to late June), are reaped before the first cotton pickings, so it is only cultivation operations which are common to both crops.

(*b*) *Maize* (*Zea mays*)

Although maize is grown in isolated patches throughout the area, it can hardly be classed as a field crop. The local type, a short-term Hickory Dent (90 days), can be planted at the same time as dura and on uninfested land can yield up to 1,000 lb. of grain per acre. On land infested with *Striga*, however, maize has little chance of survival, and without some effective control of this parasite the expansion of the maize crop into old dura cultivations cannot be contemplated.

The development of the crop on virgin land is a doubtful proposition, for *Striga lutea* is found as a parasite on the roots of various grasses throughout the short-grass savannah area; in such localities it is not difficult to envisage a primary infestation by *S. lutea* followed later by the more virile *S. hermonthica*.

(*c*) *Dukhn* (*Pennisetum typhoideum*)

Dukhn, the grain crop of the *qoz* lands (sands) and of those marginal areas of low and sketchy rainfall north of Dilling, can hardly claim a place as a field crop of the heavy clay soils. However, as a commensal or backyard crop it plays a small though not unimportant part in the agricultural economy of the cultivator. It can be planted before the main dura crop from early June, and in many cases is planted dry to await the advent of the first rains. The local types are hopelessly mixed among themselves, with further admixture from importations. Some black-awned types from Nigeria are relatively high yielders, and yields of grain up to 1,000 lb. per acre have been returned from small areas. On medium to good land, however, dukhn should not be grown, for in terms of yield it cannot hope to compete with the dura crop. Its cultivation should be restricted to those areas and sites unable to support dura, namely to the terraced ridges of rocky outcrops and to the more open *gardūd** soils in the vicinity of native villages. In general it should supplement, not replace, the dura crop.

Food Crops: Edible Oil

(*a*) *Simsim* (*Sesamum orientale*)

Statistics for the 1937-8 season indicate an area under simsim of 93,000 acres. A measure of its popularity (hence value) can be gauged from this figure, which is equivalent to six sevenths of the cotton acreage in the year of its peak production. A crop of the Kordofan sands, simsim is also well adapted to this area of heavy clays and suffers from few of the disadvantages of the groundnut crop. It can be planted after the latter from the middle to the end of July and is an ideal crop to follow late *harig* practice: in fact it is the only field crop which will stand late planting and give fair returns. Harvesting operations are from the end of October and, since the crop is above ground, present no difficulties (*cf.* groundnuts). The local types are mixed, the commonest being the large red-seeded variety, which has doubtless spread from the *qoz* lands of the north. Given fair conditions, this variety can yield up to 400 to 450 lb. of seed per acre on the lighter clays, but on heavy land infected with the local "Marad ed Dam" disease (*Pseudomonas sesami* Malkoff) the crop is a complete failure. This organism is most persistent and can remain viable in the soil for periods up to 6 to 7 years. No effective measure of control is known save that of planting resistant varieties. These have been developed at the Kamina Farm, Kadugli, from an early white type (possibly an importation) and, though not immune, offer a high degree of resistance to the disease. In spite of their lower seed weight, the white types can yield up to 350 lb. of seed per acre under the worst conditions of infection.

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* The product of rock weathering: usually found at the base of hills.

(*b*) *Groundnuts* (*Arachis hypogea*)

Although groundnuts can be grown with advantage on the lighter clay loams and the *gardud* soil type, they are not well suited to the heavier clays: an erratic October rainfall, which may range from 13 mm. to 130 mm., can present considerable difficulties in the harvesting of the crop. With droughty conditions prevailing, the crop must be dug out rather than pulled, an operation entailing much time and labour and the loss of a considerable proportion of the crop; with heavy rains toward the end of the month, harvesting difficulties are again encountered and the crop is liable to be left too long in the ground, with consequent sprouting. If groundnuts must be grown on the heavier soils, "bunch" types such as Barberton, Medani Erect, American Erect and Abu Arba are recommended to the exclusion of the local "runner" types. The former "peg down" immediately below the plant, facilitating lifting operations and minimizing the loss of nuts. The types* listed above should be planted in mid-July, with harvesting from the middle to the end of October. The crop is remarkably free from insect pests and diseases. "Rosette" disease is absent from the area and *Cercospora* leaf spot, in evidence during the ripening-off phase, has little effect on final yield.

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* **Maturation periods range from 116 days (Medani Erect) to 100 days (Abu Arba).**

(*c*) *Sunflowers* (*Helianthus annuus*)

To date there has been little incentive to grow sunflowers in the Jebels area: with the erection of an oil-extraction plant at Kadugli, a local market may be established and the cultivator's interest may be attracted to the crop. A fair range of types has been grown under observation at Kadugli, and at the outset it can be stated categorically that long-duration types such as the Russian Blacks and Striped* (maturation periods 140 to 160 days) are not suited to the area. Under the local conditions of a short growing period and a concentrated rainfall, such types exhibit marked vegetative growth and vigour, but with the sudden cessation of the rains produce poor heads, badly filled. Such late types are gross feeders and must exert a considerable drain on soil nutrients, and in view of the low head/haulm ratio it is doubtful whether they could be recommended for soils of borderline fertility. If a demand for sunflower seed arises, early types† (maturation periods 75 to 85 days) are available to the cultivator: these could be planted in mid-July (after the cotton crop) for harvesting in late October. One bad feature, common to both early and late types, is the high percentage of empty seeds per head. This lack of fertilization may be due to the continuous rains during the free-pollen stage and/or to the scarcity of effective pollinating agents during that period.

FOOD CROPS: MISCELLANEOUS

Although the two legumes soya (*Glycine max*) and tepary beans (*Phaseolus acutifolius*) have been grown in observation plots throughout the area, they have not found their way into general cultivation. In the former case, all types have been discarded, save for non-shattering Yellow, a large-seeded yellow introduced from Barberton, S. Africa. In vigour and general performance this type has far surpassed its nearest rivals, but its yield under conditions of extensive cultivation (up to 500 lb. per acre) does not approach that obtained on the clay loams of S. Africa.

Generally speaking, local conditions are all against the adoption of soyas as a commercial crop. Agriculturally they require a good deep loam, correct placement of seed at planting, a sequence of good though not heavy rains following planting and, last but not least, a modicum of attention in the early stages of growth. None of these conditions is fulfilled locally. Finally, there is no local demand for soyas and even with a commercial outlet for the crop it is extremely doubtful whether under peasant cultivation they could stand transport charges to main collecting centres.

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* Ex Barberton, S. Africa.

† Types ECR 312 and 314 ex Gezira Research Farm, Wad Medani.

Tepary bean was introduced to the Kadugli district in 1947. It was soon apparent that the crop could not tolerate early planting and the subsequent waterlogged condition of the soil during the main *kharif*; plants remained stunted and chlorotic and stands were depleted by a stem rot. Late planting at the end of August obviated such conditions and allowed the crop to mature at the end of the rainy period. In the latter case yields up to 600 lb. of grain per acre were returned from observation plots.

In spite of its short maturation period (75 to 80 days), the palatability and colour (white) of its grain and its resistance to the ravages of store pests, the cultivator has not taken kindly to the crop. Whether this is due to an inherent suspicion of a new introduction or to the notion that returns are not commensurate with the labour involved is a moot point. However, teparies merit further trial in Kordofan, not only as a very late-planted crop in the wetter regions of the south but north of the 12° N. parallel where rainfall is sketchy and sporadic and the soil moisture content lower.

(2) Cash Crops: Cotton

For the Jebels area it is difficult to envisage any possible cash crop to replace cotton. A measure of its importance can be gauged from figures for the 1938-9 season, when over 400,000 kantars* of seed cotton (American rain-fed) were purchased from the cultivator. During the war years, with priority given to food crops, cotton production suffered a severe setback: seed issue was restricted and the Eastern Jebels proclaimed a "closed" area. With the cessation of hostilities, however, cotton loomed large as a dollar-saving commodity and every effort was made to push production to its pre-war level. In spite of keen competition from dura, the crop soon regained its popularity: for the 1948-9 season Kadugli alone (one of the seven factory sites located throughout the area) purchased 76,000 kantars of seed cotton, disbursing £81,000 to the local cultivators. A general background to the crop has been given elsewhere,[2] and accounts of the experimental work of the Kadugli Station have been published annually in the Progress Reports of the Empire Cotton Growing Corporation.

Emphasis is laid on a correct time of planting, which should be at the commencement of the main *kharif*, usually from late June through the first week in July. Very early planting on the little *kharif* can entail complete crop loss, for the crop is often caught in the semi-drought period between the two rainfall phases and burnt up: late planting always depresses final yield. In the latter case, germination is not affected and good stands are obtained, but plant growth is stunted and development retarded. Experimental evidence from late July and early August plantings indicates a reduction in final yield of 47 and 64 per cent. respectively on normal planting-date figures.[5] Thus the late burning of the *harig* grasses followed by the late planting of cotton is condemned, for it is a practice largely responsible for the low average returns for the area, namely 315 lb. of seed cotton per acre.

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* 1 kantar = 99 lb.

(3) Restorative Crops: General

Restorative crops, as such, make little appeal to the cultivator: in general their cultivation is incidental to their value either as food or cash crops. While good land is available and population pressure low, the cultivator is not prepared to waste his energies on crops giving no immediate return. Under the present-day system of extensive or rather shifting cultivation the *harig* grasses collectively must be classed as the most important restorative crop. Where conditions are more stable, especially with the more sedentary tribes such as the Nuba, cowpeas play an important part in maintaining the general fertility level.* As a commensal crop pigeon pea has been included, but its acceptance as a field crop is highly improbable.

In the absence of suitable tractor-drawn implements, any system of green manuring presents considerable difficulties: even on experimental farms where ploughs are available the incorporation of a green crop into the soil is well-nigh impossible. With the very rapid drying out of the surface soil, the action of a single mould-board plough, drawn by two unwilling oxen, is merely to tear up a shallow layer leaving no true furrow or furrow-slice. A standing crop is merely displaced, not buried, and a wind-rowed crop has no furrow for final interment. On these heavy clays a further difficulty presents itself in the slow rate of decomposition of the more woody tissues of the plant, and in some cases the intervention of two rainy seasons is essential to effect a final breakdown: during the three dry seasons which intervene white ant activity is noticeably increased. At the Kadugli Station all attempts at green manuring in the strict sense have long since been abandoned and the following procedure for dealing with the restorative crop (cowpeas) has been accepted as standard practice: a maximum leaf fall is aimed at before the crop is picked; following this the fibrous haulms are removed by hand for stock feed and the land is then ploughed immediately.

The crops will now be dealt with in the order of their present-day importance.

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* All legumes save tepary bean show slight nodulation in these heavy clays; nodulation, however, is not marked, much less so than on the more open soils of subtropical regions.

(*a*) *Harig Grasses*

The most important *harig* grasses indigenous to the heavy clays are *Hyparrhenia pseudocymbaria* and *rufa, Brachiaria obtusiflora, Pennisetum mollisimum, Rottbœllia exaltata,* and *Cymbopogon nervatus.* On occasions their seed is collected by the cultivator and broadcast over his worn-out land prior to abandonment, but more generally natural re-seeding takes place from adjacent areas. These grasses are exceedingly vigorous and their rapid growth smothers out most competitors. In the early stages a good stand is required in order to avoid patchiness and subsequent firing difficulties: latterly a dense, even cover not seriously compacted by heavy rain or wind nor trampled down by stock. A nicety of timing of the actual firing is essential to the success of the system. If too early in the rainy peiod, a high percentage of grass and possibly weed seeds has not had time to germinate: if too late a dense mat of green growth prevents successful firing. The cultivator is liable to err on the side of late firing, and consequently planting dates are deferred up to the end of July. In such cases the range of crops which will give him an adequate return is limited.

The period under the grass cover is roughly proportional to the fertility status at the time of abandonment. On badly exhausted land, a lapse of 4 to 5 years is usually necessary to effect regeneration.

(*b*) *Cowpeas* (*Vigna unguiculata*)

This crop, known locally as *lubia hilu,* is seldom found growing as a pure culture: more often it is interplanted with dura, dukhn and vegetables.

In view of the importance of cowpeas in the cotton rotation at Kadugli, an effort was made to collect as wide a range of local types as possible, with special emphasis on early-maturing grain types. These were considered of first importance, for, planted from mid-July, they could supplement the grain from the early duras and thus help bridge the "scarcity gap" of August and September. Unfortunately all early types (65 to 78 days) were very susceptible to an unidentified leaf mosaic possibly carried by white fly, and those which did survive the infection were attacked at the flowering stage by swarms of *Mylabris* beetles (spp. *bifasciata* and *bipartita*) and at pod formation by the sucking bug *Anoplocnemis curvipes.* It was obvious that under field conditions such early types could not hope to survive. Attention was then directed to the selection of mid-season grain, mid-season dual-purpose and late-fodder types. It was essential that these should be resistant to the local mosaic and, by virtue of their longer maturation periods, miss the peak swarming of the *Mylabris* beetle. Of the large number of single plants selected from the various small bulks, three only stood the test of time. These were Kadugli 3, a brown-seeded, dual-purpose type of maturation period 100 days; Kadugli 47, a white-grain type of maturation period 105 days; and Kadugli 4, a red-seeded, late-fodder type of maturation period 120 to 125 days. They are now being bulked to commercial proportions and by 1951 seed should be available for local distribution. Such types can be planted with advantage from the middle to the end of July, allowing the pods to mature in the dry period of late October to early November.

(*c*) *Pigeon Pea* (*Cajanus cajan*)

The inclusion of pigeon pea in any local rotation solely for the purpose of opening up the soil must be considered of doubtful utility: the natural processes at work during the winter period producing the deep and wide cracks so characteristic of the area must be more efficacious in soil aeration than the roots of any crop plant.

Although plants of the long-duration West Indian type may be found in the neighbourhood of villages, the extension of the short-period local types into field cultivation is highly improbable. The most suitable time for sowing is early July and, in the absence of the *Mylabris* beetle, fair yields are returned from this sowing date; where beetles are in evidence, however, flowering coincides with the peak swarming of this pest and few flowers escape the attack; late planting is a possibility, but the sudden cessation of rains in October would so curtail the flowering phase that final yields would be of a very low order. May planting would solve the difficulty, but, like cotton, pigeon pea cannot survive the semi-drought period between the two rainfall phases and extreme conditions would entail complete crop loss.

The cultivator evinces little interest in pigeon pea as a field crop, and in view of the agricultural circumstances there is little reason to change his attitude.

"*Organized*" *Rotations*

In 1928 experiments were started in the Kadugli and Talodi areas to explore the possibilities of certain rotations. With cotton included as the test crop, their efficiencies were assessed in terms of the yield of seed cotton per acre, averaged over the period of the experiment. Data from these experiments,[6] in which continuous cotton is given as 100, are shown below:

KADUGLI. *Average:* 6 *years.*	
Continuous cotton	100
Cotton—fallow	90
Cotton—dura	93
Cotton—dura—lubia	115
Cotton—dura—$\left\{\begin{array}{l}\frac{1}{2}\text{ lubia}\\ \frac{1}{2}\text{ sesame}\end{array}\right.$	111

TALODI. *Average:* 15 *years.*	
Continuous cotton	100
Cotton—cotton—fallow	109
Cotton—dura—fallow	104
Cotton—sesame—fallow	110
Cotton—fallow—$\left\{\begin{array}{l}\frac{1}{2}\text{ groundnut}\\ \frac{1}{2}\text{ lubia}\end{array}\right.$	121

The most striking fact which emerges from these rotation figures is the value of a legume preceding cotton.

With groundnuts a doubtful crop on these heavy clays, pride of place has been given to cowpeas, and this legume has appeared as the restorative crop in the three-course rotation cotton—dura—cowpeas at the Kamina Farm, Kadugli, since its inception in 1938. This rotation, coupled with the " cross-tagnat " system for minimizing sheet erosion, was adopted by R. R. Anson, and a measure of its success can be gathered from yield figures from this experimental area. In 1946 and 1947, eight and nine years after the founding of the Station, 2,098 lb. of seed cotton (654 lb. lint) and 2,170 lb. of seed cotton (718 lb. lint) per acre respectively were returned from variety trial areas of 1.5 acres: in the latter season the whole of the Kamina Farm averaged 1,300 lb. of dura per acre—this in the absence of dung, compost or artificials. These figures do not indicate a fall in the fertility level; the general consensus of opinion is that there is a rise rather than a fall.

In this area of violent tropical storms, a fixed rotation system conscientiously followed is not sufficient to maintain the productivity level: some method to combat sheet erosion is an essential adjunct to the rotation adopted. A fair measure of success has been obtained locally from the " cross-tagnat " system, similar in many respects to the " tie-ridging " method[7] adopted in Tanganyika. Before the advent of the rains when labour is available, each experimental block of 3 feddans* (60 m. × 210 m.) is ridged lengthwise at intervals of 10 m. and crosswise at intervals of 35 m.† The ridges are up to 1 ft. high, and are impacted by the rains of the little *kharif* before the main deluge. The labour involved in their construction is not excessive and, in term of increased yield, is amply repaid over a series of years. Not only does the system give a " ponding " effect, but—of far greater importance—it reduces to a minimum surface scouring.

For land in good heart there seems little reason to doubt the efficiency of this joint system in maintaining the fertility; however, on worn-out land exhausted by continuous cropping the build-up would probably be too slow, and under such circumstances regeneration under *harig* grasses would doubtless be more expeditious.

SUMMARY

In view of the siting of *hafirs* throughout the Jebels area and the opening up of new roads through the black clay plains of potential agricultural value, it is reasonable to anticipate a population drift from urban districts and the establishment of small communities in the vicinity of the *hafirs*. Such settlements presuppose a concentration of both cultivator and stock and a more intensive form of cultivation. In the past, shifting cultivation has been practised and soil regeneration effected by means of the *harig* grasses. Under the new conditions the agricultural background is changing, and if valuable land in the vicinity of the *hafirs* is to be saved from exploitation and ultimate exhaustion some organized rotation must be adopted in which restorative crops play a part.

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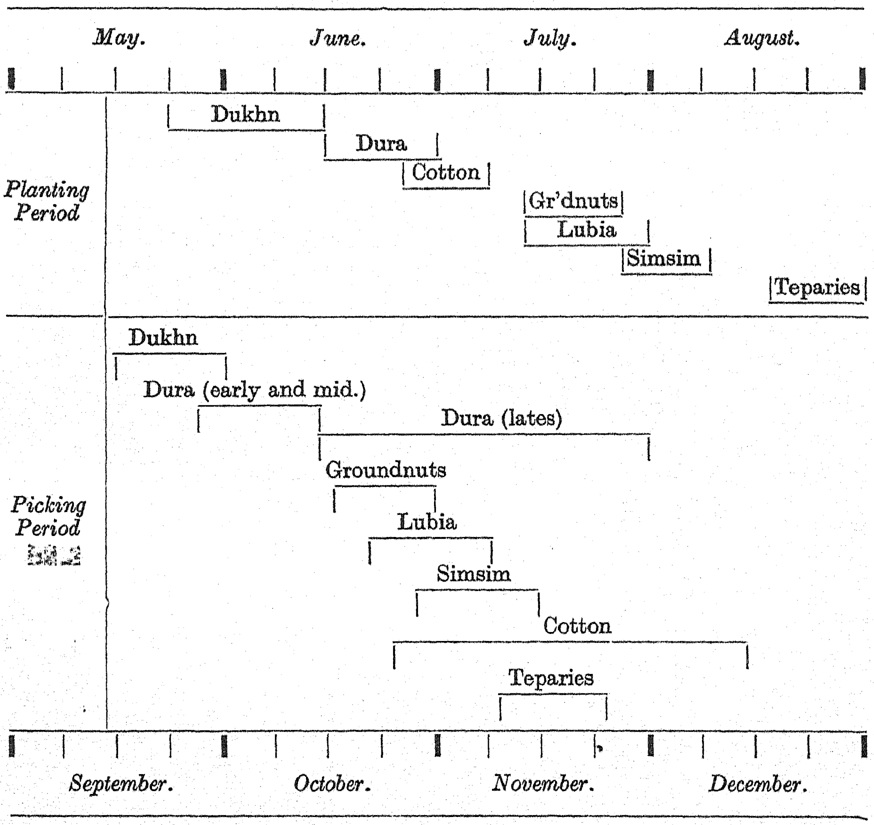
* 1 feddan = 1·038 acres.

† For any given site these figures must be related to total rainfall, maximum intensity, soil porosity, slope, etc.

A broad survey of the area under discussion has been made, including meteorological data, soil type and characteristics, local flora and the primitive agricultural system as practised. Possible field crops have been listed and discussed under the designation *food, cash* and *restorative.* In terms of the family unit the seasonal planting sequence is important, and planting dates, suitable to both crop and cultivator, have been assigned to the more important crops: such dates have been centred on the optimum planting date for cotton, namely from the end of June through the first week in July. This sequence can be more easily followed in the table below, from which is omitted field crops of doubtful utility.



Data from various rotations have been given in which the value of a legume preceding the cotton crop has been demonstrated. At the Kamina Farm, Kadugli, cowpea has been accepted as the most important restorative crop and has appeared in the three-course rotation cotton—dura—cowpea since the inception of the Station in 1938. Such a rotation, coupled with an effective cross-ridging system to minimize surface scouring, has been largely responsible for maintaining a fair level of productivity. On worn-out land, however, the fertility build-up under this joint system would probably be too slow, and in such cases soil regeneration under the *harig* grasses is recommended.

ACKNOWLEDGMENTS

As a background to the writing of this paper I have been assisted by *Agricultural Survey of the Nuba Mountains*, author R. G. Colvin, and by *Agriculture in the Sudan*, by numerous authors (editor J. D. Tothill), to whom acknowledgment is made. I am indebted to R. R. Anson, Chief Cotton Breeder, Wad Medani, for valuable information on the Jebels area, and to H. Ferguson, Chief Physiologist, Wad Medani, for reading the manuscript and for helpful suggestions.

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Received August, 1950.

DYEING OF COTTON SEED

BY

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THE cotton seed for sowing in the Sudan Gezira is from the previous season's crop grown in the Gash Delta. Two strains of cotton are grown there and it is of importance that these should be given a measure of isolation. The cultivators in the Gash are illiterate and unimpressed by the importance of this. The management in the Delta believe it would assist them in maintaining the necessary isolation if the sowing seed were distinctively coloured.

Small-scale experiments at once showed that a wide variety of stains and dyes are able to colour cotton seed in a most striking fashion when shaken with the seed with the addition of a little water.

Seed sown in the Gash Delta is always treated with Abavit B powder and a little (0·5 per cent.) water at the same time as it is heated in a rotating Simon's seed heater. Abavit B powder is a mixture of mercuric chloride and iodide in proportions of 3 to 1, with a filler, giving a total mercuric content of 5·7 per cent. This introduces two criteria for dyeing. The dye must be unchanged at 67°C. and it must not deleteriously affect the action of the Abavit B against " Blackarm " (X. *malvaccarum*) infection. The first of these requirements is easily satisfied by a wide range of dyestuffs. The second criterion proved much more difficult to pass. The point was tested by using seed known to be heavily infected and comparing the normal Abavit treatment with Abavit plus the addition of 0·1 per cent. of a number of dyes. S. A. J. Tarr, Plant Pathologist of this Division, showed that several dyes reduce the protection given by Abavit B. His results for Congo Red were, however, as follows:

Treatment	*Per cent. Blackarm*	*No. Seedlings tested*	*Per cent. Germination*
Control (Abavit B only)	0·42	16626	82
Congo Red and Abavit B	0·51	17828	84

and this dye was accordingly chosen as satisfactory.

The whole of the " Sakel " sowing seed for the Gash Delta for the 1950-51 season has been dyed with Congo Red, using dye at 0·1 per cent. of the weight of seed. For this large operation Abavit B with the dye already incorporated was purchased. The amount of seed treated was 300,000 lb. There seems little doubt that a 0·05 per cent. rate for the dye could be used satisfactorily.

It may be that this procedure will be of use in other connections, but we emphasize the necessity for showing that the dyes do not affect any seed dressings used. The germination of the seed seems to be slightly improved by a number of dyes.

Note.—Preliminary testing showed that representative dyes taken from the different types contemplated did not immobilize the mercury of the bactericide in aqueous solution as judged by the ability of hydrogen sulphide to precipitate mercuric mercury.

Laboratory testing for colouring ability was carried out on the following 16 dyes:

1. Congo Red
2. Methylene Blue
3. Saffranine
4. Magenta
5. Rhodamine B
6. Brilliant Green
7. Bismarck Brown
8. Naphthalene Orange
9. Naphthalene Black
10. Chlorazol Orange
11. Chlorazol Yellow
12. Durazol Orange
13. Naphthol Green
14. Benzopurpurine
15. Victoria Blue
16. Chrysoidine.

All the dyes distinctively coloured cotton seed at an application rate of 0·1 per cent. dye to seed. Heating to 67°C. did not impair the colour.

Received July, 1950.

REVIEWS

Agricultural Science in the Sudan. By R. L. Knight and B. M. Boyns. (T. Buncle and Co., Arbroath. 1950. £1 net.) The development of cotton production in the irrigated areas of the Sudan has encountered many difficulties and been faced with many problems specific to the situation and circumstances. These have called for long-continued and many-sided research, and it is fortunate that financial prosperity has made it possible to enlist and to maintain the succession of able scientific investigators who have been attracted to the work. The Minister of Agriculture, Miralai Abdalla Bey Khalil, in his foreword, describing the great accessions of wealth to the Sudanese people which the development of agriculture in the last fifty years has brought, recognizes that its continuance has depended on the ability of agricultural science to meet recurrent crises with their appropriate remedies.

It is an excellent idea at this time, the end of a period of outstanding commercial and scientific effort and the beginning of a new dispensation, to collect in one volume a list which runs to 969 entries of publications dealing directly with or having some useful reference to the progress of investigation and the recording of observations in agricultural science in the Sudan. The book goes much further than a simple bibliographical list in that the references to all the more important contributions are supplemented by abstracts, often of very considerable length. Opinions differ as to the desirability of providing more than a summary of the contents of scientific communications, the view being held by some that a full abstract is too often accepted as a substitute for the original. There can, however, be no question of its practical convenience to the worker whose contacts with a first-class library are few and far between, and of its usefulness in avoiding the disappointments which the searching out of an original paper so often brings.

The entries are arranged alphabetically under the names of authors, so that the collection of information on any particular subject depends upon the index. This would seem, so far as can be checked by inspection, to be fully adequate for the purpose. W. N.

Experimental Designs. By William G. Cochran and Gertrude M. Cox. (John Wiley and Sons Inc. New York. Pp. 454. $5.75.) It is a great pleasure to review this excellent book on a subject which has become of increasing importance in recent years. Both the advanced experimenter and the biologist with a bare working knowledge of experimental statistics will welcome the opportunity of studying the wide range of designs which have been accumulated under one cover.

Hitherto information on the comparatively recent subject of experimental design has been dispersed over literature, much of which was available only in first-class libraries. Also, in many reports of experiments a special knowledge both of the subject and of advanced statistics was required for a full understanding of the methods employed. The authors have now made available a logically arranged and interestingly presented discussion of such fundamental conceptions as the analysis of variance and confounding, hitherto available only in text-books on mathematical statistics. As the authors point out, the presentation of such a complex subject as the analysis of variance is necessarily condensed, but adequate references are given for further study. Among the fundamental assumptions underlying the analysis of variance brief but pointed reference is made to remedial measures to be taken when it is suspected that data do not fit, at least approximately, the normal distribution.

Following the review of basic statistical principles, the authors expand the main theme of the book—the advantages and application of modern factorial designs. Here their vast experience covers most situations which can be envisaged by such widely differing interests as those of the plant breeder and the domestic science teacher.

Considering the wealth of detailed examples one could have wished for a fuller treatment of various methods of transforming skew data, without the necessity of referring to additional literature. Also, bearing in mind this difficulty of obtaining such references at remote stations, it is a pity that rotation experiments have not been covered. These are minor criticisms which do not detract from the excellence and timely appearance of the book, and it may be claimed that the biologist with no special statistical training now has to his hand a compendium which takes him through what has hitherto been considered the bewildering maze of modern statistical methods.

H. L. M.

A SHORT HISTORY OF AGRICULTURE IN THE BRITISH COLONIES. By G. B. Masefield. (Oxford: at the Clarendon Press, London: Geoffrey Cumberlege. 10s. 6d. net.) The reviewer must confess that he opened this book with some misgivings. To the few survivors of the men who were associated in the early years of this century with the first organized application of scientific study to British tropical agriculture, and have taken part in the development of the colonial agricultural services as they exist today, the difficulties of compressing this complicated and eventful experience into a small volume must appear insuperable, especially in view of the scattered, fragmentary and uneven records available. A short history is naturally much more difficult to write than a longer one. There is the difficulty of selecting from the material those things which are of lasting significance, and, still more, of making sure that none of importance has been omitted.

A critical perusal of the work has removed these *a priori* doubts. It is true, as the author himself states in his conclusion, that much detail of the greatest interest has had to be omitted, but he can be credited with having brought out the salient facts and with having dealt with them in a form which makes the book not only instructive but interesting to read. It is, in fact, remarkable how much he has been able to include. Not only will the book be useful for those students concerned by providing them with the background for their future work, but it could be read with profit by tropical agriculturists at any stage as a successful effort towards the co-ordination of past experience in relation to further progress.

It is the duty of the reviewer to point out defects, if he can. The most serious of these which has been noted is the omission, in the account of the agricultural history of the West Indies, of reference to the immensely valuable contribution of the Sea Island cotton industry (established by Sir Daniel Morris and fostered by the Imperial Department, the British Cotton Growing Association and later the Empire Cotton Growing Corporation) to the renewed prosperity, after they had been deserted by the sugar industry, of St. Vincent and Montserrat, and of other islands in a lesser degree.

Another point which deserves to be stressed in relation to soil conservation is the contrast which used to prevail between East and West in the handling of tree crops. The clean weeding policy of the East, as opposed to the practice of trimming the ground vegetation in the West, was a subject of lively controversy. Examples have been seen where the former policy, transferred to Africa from Ceylon, has had disastrous results in facilitating soil erosion, and the necessity for the Ceylon planters to use large quantities of artificial manures was attributed, by the opponents of clean weeding, to the loss of their soil from this cause.

On a point of detail, the " sudden death " of clove trees in Zanzibar (p. 123) had given rise to official concern (and had led to the special appointment of a mycologist) several years before the nineteen-thirties.

The book includes within its scope, so far as information permits, the history of its subject from the earliest times, and selected bibliographies are appended to its successive sections. W. N.

THE JOURNAL OF EXPERIMENTAL BOTANY. (Oxford: at the Clarendon Press, London: Geoffrey Cumberlege. 14s. net. Subscription: 3 numbers, 35s. post free.) We have received for review Number One, Volume One of this botanical journal, dated March, 1950, sponsored by the Society of Experimental Biology as a medium for the publication of papers in the field of plant physiology, biochemistry, biophysics, experimental agronomy and related topics. The editor is Professor T. A. Bennet-Clark, supported by an editorial committee of distinguished botanists. The papers included in this first number with one small exception are concerned with questions in plant physiology and allied biochemistry, and might quite appropriately have appeared in the *Annals of Botany* or the *New Phytologist*. In view of the increased activity of investigation since these journals held the field, it may confidently be assumed that the additional medium for publication will be welcomed by authors, and its existence, with a restricted though wide programme, may lead to a greater degree of specialization in all three. Such a development would be in accordance with the modern trend which, though it may be regretted, is clearly inevitable.

W. N.

NOTES ON CURRENT LITERATURE

COTTON IN INDIA AND PAKISTAN

413A. INDIA: CROP PROSPECTS. (*Cott. and Genl. Econ. Rev.*, 28/7/50.) The raising of the ceiling prices for the new crop by Rs. 150 (a 24 per cent. increase in price), together with the other measures the Government have already taken, is expected to encourage growers to plant a larger acreage this season. The cotton area has recently had favourable rains and growing conditions are reported to be good. Provided there is no serious damage to the crop by unfavourable weather, disease or pests (locusts are reported to be swarming in Arabia and may perhaps be a crop factor next season), it is hoped that production will be increased by 800,000 bales. If these hopes are fulfilled, supplies of Indian cotton will be considerably larger next season and there will be a margin for increased consumption in India, and there may be more Indian cotton for export. At the present time, apart from a very small quantity of Comillas, no exports are permitted from India the quota for the season having already been filled.

414. PERENNIAL COTTONS. By R. Balasubrahmanyan. (*Ind. Cott. Grwg. Rev.*, iv, 1, 1950, p. 60.) In India there are still three perennial cottons which continue to be cultivated to a limited extent. They are *nadam* of Coimbatore, *podupathi* of Vizagapatam and *rozi* of Guzarat belonging to *Gossypium arboreum.* Each variety is noted for special agricultural characters, and efforts at replacement by better annuals have so far been unsuccessful. *Nadam* cotton has the capacity to resist drought and stem weevil (*Pempherulus affinis*) and records the lowest percentage of insect-damaged seed cotton in annual harvests. *Podupathi* is noted for its hardiness and fibre strength. *Rozi* is more or less immune to root rot. The present position as regards these three cottons can therefore be stated as (*a*) they are unlikely to be replaced in the near future by hardy annuals capable of withstanding the rigours of climate, poverty of the soil or incidence of diseases and pests, and (*b*) no measures short of legislative compulsion can effectively ban their cultivation. In this note the two aspects of the problem, namely the working of the Cotton Pest Act in Madras and the desirability of advocating quality South American perennials for general cultivation, are dealt with.

415. HILL COTTON IN ASSAM. By S. R. Barooah and B. De. (*Ind. Cott. Grwg. Rev.*, iv, 1, 1950, p. 65.) In Assam cotton is grown mostly on hills at altitudes varying from 500 to 3,000 ft. above sea level, where it gets a good drainage facility, in spite of heavy rainfall in the hills, which averages 80 to 120 inches annually. The factor of good drainage, obtainable in the hills, alone allows the crop to thrive and grow well. The crop consists mainly of the type *Gossypium arboreum* var. *cernuum*, the Garo Hills in Assam being its centre of origin, but a recent botanical survey of the hill cottons revealed that the present crop is a mixture of segregating types showing a very wide range of variations of important economic characters. The methods of cultivation are described. In general the cotton is too coarse and short for mill requirements, but it finds a ready market owing to its suitability for the local hand-weaving industry and for mixing with wool. It is unlikely, therefore, to be replaced by longer-stapled cotton, which would have great difficulty in withstanding the prevailing weather conditions.

416. TECHNOLOGICAL REPORTS ON STANDARD INDIAN COTTONS, 1949. By D. L. Sen. (Ind. Cent. Cott. Ctte., *Tech. Bull.*, Ser. A, 72, Nov., 1949.) This bulletin contains the detailed results of tests on standard cottons of 1948-49 season, together with the results for the previous seasons. It also gives the agricultural details, the grader's valuation report and the spinning master's report on each cotton as well as complete information regarding the treatment, waste percentages, yarn breakages and the physical conditions prevailing in the laboratory.

417. TECHNOLOGICAL REPORTS ON TRADE VARIETIES OF INDIAN COTTONS, 1949. By D. L. Sen. (Ind. Cent. Cott. Ctte., *Tech. Bull.*, Ser. A., 73, Jan., 1950.) The plan followed in presenting the results of tests carried out on trade varieties is similar to that adopted in the Technological Reports on Standard Indian Cottons. Fibre tests are not made on trade varieties, however. In addition to Indian cottons, tests of three varieties of East African cottons (A. R. Kampala, A. R. Busoga and A.R. Jinja) have been included in this bulletin, as these cottons are used in considerable quantities in the Indian mills and the Indian cotton trade is interested in them. Since A.R. BP 52 has replaced A.R. Kampala quality in almost all areas where it was previously grown, the test results of the former cotton are included from 1945 onwards in place of the results for A.R. Kampala in this bulletin.

418. INDIAN COTTON TEXTILE INDUSTRY, 1947-48 ANNUAL. By M. P. Gandhi, Ed. (Gandhi and Co., Bombay. Price Rs. 6. From *Indian Farmg.*, x, **10**, 1949, p. 468.) The developments connected with the various aspects of the Indian Cotton Textile Industry during 1947-48 have been comprehensively dealt with in this Annual. Several constructive suggestions have been made while discussing the present position and future prospects of the industry. The necessity for a larger expenditure on research and extension work for improving the quality and increasing the quantity of raw cotton production in India, particularly in the light of the effects of the partition of the country, has been stressed in the Appendix relating to raw cotton. This is an issue which cannot be emphasized too often in view of its importance to the national economy of the country.

Besides useful statistical data which are presented separately to give an idea of the industry at a glance, the Annual contains the texts of important control orders and up-to-date lists of cotton mills in India and Pakistan. The usual Appendix on the handloom weaving industry has been revised and enlarged.

419. SOIL CONSERVATION IN INDIA. See Abstract 480.

420. PAKISTAN: FINAL FORECAST OF COTTON CROP, 1949-50. (*Cotton*, M/c., 10/6/50.) The final forecast of the area under cotton for the year 1949-50 is 2,811,000 acres (American varieties 2,476,000 acres and Desi varieties 335,000 acres) as against 2,799,000 acres (American varieties 2,347,000 acres and Desi varieties 452,000 acres) of the previous year and shows an overall nominal increase of 0·4 per cent. The area under American varieties has been increased by 5·5 per cent. and that under Desi varieties has fallen by 25·9 per cent.

The final forecast of the yield of this crop is 1,172,000 bales of 400 lb. each (American varieties 1,065,000 bales and Desi varieties 107,000 bales) as against 1,019,000 bales (American varieties 866,000 bales and Desi varieties 153,000 bales) of the previous year and shows an increase of 15·0 per cent.

421. DRAINAGE AND RECLAMATION OF IRRIGATED LANDS IN PAKISTAN. See Abstract 481.

COTTON IN THE EMPIRE

422. EMPIRE COTTON GROWING CORPORATION: ANNUAL GENERAL MEETING, JUNE, 1950. The Chairman reported that the Council had elected Lord Peel as President of the Administrative Council in succession to Lord Linlithgow, who has resigned after holding office for five years. In presenting the Report of the Administrative Council it was announced that the Raw Cotton Commission had generously made a grant of £15,000 towards the capital cost of the new Cotton Research Station in Uganda. The station is to be officially opened in November by the Governor of Uganda, and representatives from nearly all the cotton-growing territories in Africa are expected to attend the opening.

423. CEYLON: COTTON CULTIVATION IN THE SOUTH-EASTERN DIVISION. By H. A. Pieris. (*Trop. Agricst.*, cv, **3**, 1949, p. 117.) After a break of five years during the war period, cotton cultivation has been re-established in the South-Eastern Division of Ceylon. A planned programme has been arranged for the distribution of pure BP.79 seed raised at the Cotton Rotation Station, Wirawila. In the 1948 season over 2,000 acres were sown and the average yield was 5 cwt. of seed cotton per acre.

424. CYPRUS: COTTON CROP. (*Ann. Rept. Dept. Agric.*, 1949.) The area under cotton, although showing an improvement over recent years, is still about half what it was before the war. With the early cessation of rains cotton sown on unirrigable lands suffered from drought. Nevertheless yields in general were very satisfactory, and for a 15 per cent. increase in area there was a 70 per cent. increase in lint over 1948. Interest continues to be shown in the American Upland variety "Coker 100," the lint from which appears to be meeting with some demand for export. Towards the end of the year the Government Spinning Mill, which had been taking this variety, discontinued operation and was offered for sale.

The total production amounted to approximately 333 tons of lint and 677 tons of cotton seed harvested from approximately 6,000 acres.

425. AFRICA. COTTON IN AFRICA. (Nat. Cott. Coun., Tenn., May, 1950.) In view of the growing interest in cotton production in Africa and because so little was known in the United States about the production possibilities of the continent, the National Cotton Council made a first-hand investigation of all the principal areas for the purpose of studying the status and trends, the problems and possibilities of cotton and cotton textile production there. This report is a summary of the detailed studies of the various areas.

426. KENYA: CROP PROSPECTS. (*Rep. E. Afrn. Commsr.*, 1949.) There was a slight increase in the acreage planted to cotton for the 1949-50 season at 48,100 acres as against 43,000 acres for the previous season, and it is estimated that the crop may reach 9,800 bales, of which 8,800 will be from Nyanza Province and the balance from the Coast Province.

427. LOCUST THREAT. (*Crown Colnst.*, July, 1950, pp. 446 and 449.) The Desert Locust Survey Advisory Committee has advised that the start of a new plague of desert locust threatens East Africa. If the worst happens, with favourable breeding conditions producing swarms on a scale too large for the control operations in Ethiopia and the Somalilands, swarms may reach Kenya's borders in December next and breed in the Northern Frontier District during the long rains of 1951. It is, however, more probable that the first swarms will not reach the Kenya borders until November-December, 1951, and it is hoped that action now being taken will prevent serious numbers of swarms from entering the main crop and grazing areas.

In order to deal with the outbreak a Control Organization has been set up separate from, but parallel to, the Desert Locust Survey. The Organization will be administered by the East Africa High Commission and directed by an Executive Committee and Chief Locust Officer. For the summer breeding period May to September, 1950, operational bases staffed by about 30 officers were being developed at Asmara, Aden and Hargeisa, and some 70 vehicles belonging to the Organization will be available apart from hired transport.

Funds for these operations are being provided by the same territories which subscribe to the Survey (Kenya, Tanganyika, Uganda, Somalia, British Somaliland, Eritrea, Tripolitania, and the British Government). It is estimated that control measures for January to September, 1950, will cost about £200,000. The Survey has been kept apart from the Control Organization in order to ensure that investigation can continue without interruption.

428. NIGERIA: COTTON INDUSTRY, 1950. (*Half-yrly Rpt. to June*, 1950.) *Northern Provinces.*—American cotton purchased for export during 1949-50 amounted to 57,487 bales (400 lb.), for which the price of 4d. per lb. was paid as a flat rate at all markets. The area under cotton was again increased owing to the enhanced price paid the previous year. In spite of a generally poor rainfall throughout the season and yields probably below average, the total purchases were greater. The factors responsible for this increase were the late start to the rains, which made cotton a better crop to plant than groundnuts, and the greatly reduced demand from the local trade owing to plentiful supplies of cotton goods. However, purchases were still below the 1940-41 record of 65,693 bales. Growing conditions were poor in that rains were late and light so that considerable areas of cotton on the uplands dried out before maturing.

At the Daudawa Seed Farm multiplication of Strain 26C has continued and there are 256 tons of seed available for Stage 4 distribution compared with 175 tons in 1948-49. The Cotton Marketing Board has financed the purchase of 270 tons of superphosphates for application in the multiplication areas to increase production. This is now being used. Dusting machinery and agrocide powder are on indent to protect the early stages against pests. For the 1950-51 season distribution of cottonseed reported so far amounts to 8,258 tons, an increase of 682 tons over the 1949-50 distribution. Drought in June delayed planting. The tendency continues for cotton to replace groundnuts in the areas where both grow satisfactorily. This is due to cottonseed being freely obtainable and more tolerant to late planting. An increase on the 1949-50 crop is likely if the end of season rains are favourable. There has been an increase in the number of bales produced for export per ton of seed distributed from 3·26 in 1947 to 7·59 in 1949.

Western Provinces.—The total amount of cottonseed available for distribution this year was 39,898 lb. The season has been favourable, but the price paid has not stimulated planting in the Meko area. In Oyo Province, where cotton forms an established part of the rotation, some interest is being shown. The whole position with regard to cotton in Western Provinces is under review and hinges mainly on stimulating production in the Meko area. Purchases of seed cotton for the half-year amounted to only 144 bales.

429. TRANSPORT OF COTTON CROP. (*Crown Colnst.*, July, 1950, p. 416.) The Nigerian Government have a programme of road construction and improvement in hand in the northern region, where the transport of seed cotton to the ginneries would be helped by better roads. Rail transport for the ginned cotton lint should be adequate.

430. NYASALAND: COTTON CROP. (*Dept. Agric. Rept.*, Pt. I, 1948. Received 1950.) It is reported that the cotton season for the year under review was on the whole most satisfactory; planting, growing and harvesting weather was favourable. The damage caused by the red bollworm (*Diparopsis castanea*, Hmps.) was not as great as in 1947, although the second-phase emergence was large and in the Port Herald Section destroyed most of the first crop. Damage caused by stainers was more prevalent especially in the Mlolo and Makwira areas of the Lower River District. Damage to bolls was also caused by the Pentatomid (*Calidea dregii*, Germ.) and the Capsid (*Helopeltis bergrothi*, Reut.). The total crop was a record one: the Southern Province marketed a total of 7,096 short tons of seed cotton, whilst in the Central Province 213 tons were purchased.

431. COTTON CROP. (*Dept. Agric. Rpt.*, July, 1950.) The latest figure available for the Ngabu crop show a total sale of 210,888 lb. Picking has begun in the Lisungwe area, but no appreciable quantity will be ready for sale from Port Herald and Northern Chikwawa until early August. Central Province prospects continue poor and the crop may be less than 60 short tons. In the Karonga area, where the latest planting date is July 15th, crop prospects are good.

432. SOUTH AFRICA: COTTON CROP, 1949-50. (*World Crops*, July, 1950, p. 316.) The 1949-50 cotton crop, now being picked in the Union of South Africa, is expected to reach a near record of 16,000 bales (500 lb. gross) from a planted area of 32,000 acres, compared with estimates of 4,000 bales and 8,000 acres in 1948-49. The sharp increase is attributed to higher prices stimulated by a rapidly expanding domestic spinning industry and to the recent development of a variety that is resistant to the Jassid pest. Yields of about half a bale per acre were normal, but heavier yields were in prospect until damage was sustained from drought and bollworm attack.

433. COTTON INDUSTRY. (*Cott. and Genl. Econ. Rev.*, 14/7/50.) There are at the present time four mills in the Union spinning medium cotton counts and a further four are weaving grey sheeting and drills. In addition there are one or two mills which are spinning waste up to counts of about 3's and 4's, which are used for weft in the weaving of kaffir sheeting. A further mill is in the course of construction in the Transvaal which will be concerned with the manufacture of heavy industrial ducks, whilst other smaller projects are also in the course of construction, most of them intended for limited production of such items as towelling and dress materials. The requirements of South African spinners are estimated at between 40,000 and 50,000 bales annually.

Until this year there has been only one gin in the Union. This is situated at Barberton in the Eastern Transvaal. Messrs. Ralli Bros. are now constructing a further gin at Magut in Natal.

434. SOUTHERN RHODESIA: COTTON CROP. (*E. Afr. and Rhod.*, 11/5/50, p. 1119.) In his budget speech the Minister of Finance stated that the prospects for the 1950-51 cotton crop remain extremely good. Though emphasis is now being placed on industrial development, the cotton-spinning scheme at Gatooma originated in a desire to give security to the Rhodesian cotton-grower. The growing side of the industry has been making progress as a European and native crop for some years, and quite recently, in response to incentive prices, there has been remarkable expansion of cotton-growing.

The provisional estimate of Rhodesian seed cotton production for 1949-50 is 7,450,000 lb., which is more than two and a half times the production in 1948-49. If this estimate is realized it will provide approximately 2,000,000 lb. of lint for spinning and 2,500 tons of cottonseed for livestock feeding. Expansion of the industry is now within measurable sight of meeting the needs of the Gatooma mill, but further expansion in spinning capacity, which has already been planned, will ensure a ready market for at least three times the present local production of seed cotton.

Interesting evidence has been secured during the year at the Trelawney Research Station that cotton may prove the means of clearing eel worm from infested tobacco lands.

435. CROP PROSPECTS. (*Crown Colnst.*, August, 1950, p. 519.) The cotton crop grown in the Native Reserves increased from a mere 75,500 lb. in 1947 to an estimated 4,643,000 lb. this year, when Africans are expected for the first time to grow more cotton than Europeans. Cottonseed is issued only to those who follow an approved rotation; so this cash crop is providing a powerful incentive to Africans to adopt good farming practices.

436. WATER CONSERVATION IN SOUTHERN RHODESIA. (*World Crops*, June, 1950, p. 274.) In the past year 371 dams were constructed in the 70 Intensive Conservation Areas of Southern Rhodesia. These dams have a combined capacity of more than 750 million gallons. In all, the year's work resulted in the full protection of nearly 150,000 acres, and farmers have voluntarily agreed to protect all cultivated land by the end of the next planting season.

The total of conservation works built in the Colony under supervision of the National Resources Board and Irrigation Department from 1946 to date, excluding minor works holding half to one million gallons each, is 2,316 dams and weirs of varying sizes, providing an aggregate storage of about 28,800,000 gallons of water, or an amount equal to nearly six times the capacity of the Mazoe Dam. The majority of these works have been constructed by private concerns with the advice of the Department.

437. SUDAN: COTTON CROP. (*Dept. Agric. Cott. Rept.*, June, 1950.) The official estimate of the acreage and indicated production for the present season is as follows: Sakel types: 318,916 feddans, 1,240,309 kantars; American types: 95,448 feddans, 100,753 kantars.

438. FIVE-YEAR DEVELOPMENT PLAN. (*Crown Colnst.*, August, 1950, p. 517.) It is estimated that the current Five-year Plan, costing £E10 million, will be completed by June, 1951. The largest single item in the plan is £E1 million to the Equatorial Projects Board, and this is being spent on the Zande Scheme. This scheme has involved the resettlement of 50,000 families into orderly village units, each village containing about 50 families and each householder having an allotment of about 35 acres. Previously the Zande were scattered; the education, medical services and the development of the territory were severely handicapped. Now, cotton, groundnuts and palm oil are being produced under proper supervision, a ginning factory has been started, and a spinning and weaving factory, the only one in the country, will be functioning in 18 months' time.

439. COTTONSEED OIL MILL IN THE SUDAN. (*Crown Colnst.*, August, 1950, p. 481.) The latest oil factory in the Sudan is an enterprise undertaken by the Sudan Oil Mills, Limited, of Khartoum North. The machinery was installed only a few months ago, and although production is not far beyond the experimental stage it is developing rapidly. The premises have a siding connecting with the railway. The factory is turning out about 8 tons of oil a day and some 20 tons of cake. In time there will be added to this output a considerable quantity of soap. The cottonseed used is entirely Sakellarides. The company is a private one, but it is interesting to note that 10 per cent. of the Ordinary shares have been allotted to Sudanese investors.

440. LOCUST INVASION. (*Crown Colnst.*, July, 1950, p. 449.) A report issued in June said that the appearance of locust swarms along the Eritrean coast and in the Northern Province of the Sudan indicated that the invasion of North-East Africa from Arabia had begun. This invasion could be expected to continue on an increased scale and to spread further west in the Sudan. The plague was developing at an alarming rate, but it was still in its early stages. Intensive control operations in all the summer breeding areas were essential to save the crops and to reduce the danger of its spread.

441. TANGANYIKA: COTTON CROP. (*Cott. and Genl. Econ. Rev.*, 30/6/50.) The cotton-buying season in the Lake Province district commenced from July 2. The original crop estimates of 50,000 bales have been modified to 40,000 bales owing to heavy incidence of pests. The price of seed cotton payable to the growers there is reported to have been fixed at Sh.25/- per 100 lb. (against Sh.24/- per 100 lb. paid last year), whereas the ginners will get from the Government a price of about cents 108/- to 109/- per lb. of lint, inclusive of ginning and baling charges plus some margin.

442. UGANDA: COTTON CROP. (*Crown Colnst.*, August, 1950, p. 516.) The Uganda cotton crop this year, estimated at 320,000 bales, is now officially expected to total 340,000 bales. This will be only 40,000 bales less than last year's total. Good rains were experienced throughout the Protectorate except in the Northern Province, and planting for next season's crop has begun in the Eastern and Northern Provinces. Increased acreages have been planted with food crops, and food supplies are adequate.

443. CENTRAL COTTON RESEARCH STATION. (*M/c. Guardn.*, 17/6/50.) It was reported that the Raw Cotton Commission had made a grant of £15,000 towards the capital expenditure on the Central Cotton Research Station established by the Empire Cotton Growing Corporation at Namulonge. The original estimate of the cost of this station amounted to £206,500, but it recently became clear that the station could not be fully established for that sum owing to the continuous rise in the cost of materials, labour and equipment. The grant will enable the station to be completed and equipped with all essential implements and apparatus on the lines originally planned.

444. COTTONSEED INDUSTRY. (*Rep. E. Afrn. Commsr.*, 1949.) In Uganda the 1949 cotton crop produced 150,000 tons of seed, from which, after the planting requirements of the growers and fuel supplies for ginneries had been met, 1,200,000 gallons of oil and 20,000 tons of cake were produced. Of the oil cake 12,000 tons were exported to the United Kingdom and 8,000 tons to Kenya. 60,000 tons of cottonseed were exported to the United Kingdom.

445. COTTON PRICE ASSISTANCE FUND. (*Brit. Territs. in E. and Cent. Afr.*, 1945-50. Cmd. 7987, 1950.) When the Uganda Government during the war introduced fixed prices for the season's crops of cotton and hard coffee it set up price-stabilization funds which could accumulate moneys in years of high prices for the assistance of producers if prices should fall later on. These two funds—the Cotton Price Fund and the Hard Coffee Fund—were wound up as at September 30, 1948, and the accumulated sum standing to their credit, amounting to over £10 million, distributed, partly to new price assistance funds for cotton and hard coffee, partly to the Cotton and Hard Coffee Development and Welfare Fund (for central food storage, agricultural loans, loans to co-operatives, land banks and building societies, and African housing), partly as grants to African local administrations, and partly as a grant to a reserve fund for development schemes and general social services. The Cotton Price Assistance Fund thus created received £3,425,000, and with subsequent trading profits now disposes of some £8 million. The marketing of raw cotton in Uganda is now the responsibility of the Lint Marketing Board, which fixes the price at the beginning of the season and is the sole channel through which ginners sell to exporters.

446. WEST INDIES: COTTON CROP. (*W. Ind. Comm. Cir.*, June and July, 1950.) Details of the West Indian Sea Island cotton crop for the 1948-49 season are as follows: Antigua, 924,864 lb.; Barbados, 58,274 lb.; Montserrat, 366,966 lb.; Nevis, 310,385 lb.; St. Kitts, 231,089 lb.; Anguilla, 4,864 lb.; St. Vincent, 343,775 lb.; making a total of 2,507,217 lb. lint. The production of Marie Galante cotton in 1948-49, all from Carriacou, was 491 bales.

The West Indian Sea Island Cotton Association have now issued estimates of acreage and production for 1949-50; the acreage totals 14,400 acres and production is estimated at 1,867,658 lb.

447. LEEWARD ISLANDS. (*Rep. Dir. Agric.*, 1948.) This report includes statistics of cotton production in Antigua, St. Kitts, Nevis, Anguilla and Montserrat for the period 1939 to 1949. An account is given of the manurial experiments on cotton carried out at the Central Sea Island Cotton Breeding Station. The materials used for these trials were ammonium sulphate, superphosphate, cottonseed meal and pen manure. All treatments gave yields higher than the control, cottonseed meal being highest with an increase of 72 per cent., with ammonium sulphate next, closely followed by pen manure. The phosphate treatment gave the small increase of 9 per cent.

COTTON IN THE U.S.A.

448. UNITED STATES: COTTON CROP, 1950. (*Cott. and Genl. Econ. Rev.*, 4/8/50.) It is reported that frequent rains, inadequate sunshine and subnormal temperatures over the main cotton belt, excepting Central and Southern Texas, favoured weevil activity, reduced the effectiveness of poisoning, promoted rank growth and hindered cultivation. Boll weevils are reported from South-Western Oklahoma, where they seldom appear. Cotton is making satisfactory development in the far south-west, although some wilt has been noticed in the Lower San Joaquin Valley. Private estimates of the current crop average around 11,500,000 bales, which compares with a final yield of 16,127,000 bales (500 lb.) last season.

449. ACREAGE ALLOTMENTS AND MARKETING QUOTAS IN THE UNITED STATES OF AMERICA. By P. K. Norris. (*Egyptian Cott. Gaz.*, **10**, May, 1950, p. 14.) The present programme of acreage allotments and marketing quotas is for the purpose of adjusting the supply of United States cotton to the estimated domestic and foreign demand and maintaining the purchasing power of cotton-growers. The Agricultural Adjustment Act makes it mandatory upon the Secretary of Agriculture to proclaim a national marketing quota whenever he finds that the "total supply" of cotton for the marketing season (August 1 to July 31) exceeds the "normal supply." The total supply is defined as the amount of carry-over on August 1, plus the indicated current production, plus the estimated imports during the current marketing year. The " normal supply " is defined as the estimated domestic consumption during the current marketing year, plus the estimated exports, plus a reserve equal to 30 per cent. of the sum of these two items.

It is comparatively easy to regulate the marketing of cotton in the United States, because cotton-growers bring their cotton to the gin in units that make a bale. The cotton is ginned in the name of the grower, who sells it and pays the ginner for the service. It is therefore a simple matter to check ownership. The law provides that the marketing quota for a farm shall not be less than the quantity of cotton which is produced on the acreage allotted to the farm.

450. RESEARCH GAINS IN AMERICAN COTTON. See Abstract 520.

451. COTTON PEST CONTROL. (Nat. Cott. Coun. Amer.: 1950 Recommendations.) This bulletin should be of interest to cotton producers; to research and educational groups; to manufacturers, mixers and handlers of insecticides; and to the cotton industry. Methods of application are given and the properties of the insecticides recommended are described in a comprehensive list. Related cotton statistics for 1949 are given for each State concerned.

452. RELATION OF SIX ELEMENTS OF RAW COTTON QUALITY TO STRENGTH OF 22S AND 50S YARN (LONG DRAFT). By R. W. Webb and H. B. Richardson. (U.S.D.A., Prodtn. and Marktg. Admin., Cott. Branch, April, 1950.) This is the eighth report in the series made from a study of relationships of cotton fibre properties to manufacturing performance and quality of manufactured product. Skein strength of 22s and 50s carded warp yarn, processed on long-draft roving and spinning equipment, is reported herein, as related to upper half mean length, uniformity ratio, fibre fineness (weight peri nch), fibre tensile strength, percentage of mature fibres and grade of cotton.

This study included 828 cottons of American Upland type from the test series for selected cotton improvement groups and the Experiment Station Annual Variety Test Series, crop years 1945-47. The data representing these cottons were stratified by crop years, series, variety, individual staple lengths and staple-length combinations.

453. MINIATURE SPINNING TEST LABORATORY. (*Text. Bull.*, **4**, 1950, p. 100. From *Text. Tech. Digst.*, **7**, 6, 1950, p. 425.) A miniature spinning test laboratory, the first in the United States, is to be established this summer at the University of Tennessee, Knoxville. The new facility will be designed to save up to 3 years' time in the evaluation of new cotton strains. A $25,000 initial grant is being made by the United States Department of Agriculture, division of cotton and other fibre groups, in the bureau of plant industry, to establish the laboratory.

454. CARRY-OVER OF COTTON ON JULY 31, 1950. (*Cotton*, M/c., 8/7/50.) The New York Cotton Exchange states that it appears likely that United States consumption of the staple during the full current season may total around 8,850,000 bales and that exports may reach a level of 5,300,000. Allowing an estimated 50,000 bales for cotton destroyed during the season, a full season distribution of around 14,200,000 bales appears to be in prospect. With the supply for the full season estimated at 21,500,000 bales, a carry-over of all cottons in all hands in the United States on July 31, 1950, of about 7,300,000 bales would be in prospect. The carry-over last season was 5,287,000 bales.

455. ARIZONA: COTTON BREEDING, 1946-47. (*58th Ann. Rept. Arizona Agric. Expt. Sta.*, 1946-47. From *Pla. Bre. Abs.*, **19**, 1949, p. 486.) Progeny rows of five new hybrid strains were grown. Two are crosses between Santan Acala and New Mexico 1517, two are back-crosses of Santan on Santan ×N.M.1517, and the fifth is a cross between Santan and Stoneville 2B. All have slightly longer and much stronger fibre than Santan. The yarns of two of the new strains which were subjected to spinning tests were superior to that of Santan. Progenies of multiple crosses of S×P, Tanguis, Sea Island and Upland, made in order to obtain strong fibre, larger bolls, smaller plant size and increased earliness, were grown in comparison with the standard variety S×P. Twenty-six of them are distinctly superior to S×P in earliness, productiveness and plant type. Considerable progress has been made in establishing strains with larger bolls than S×P.

456. GEORGIA: COTTON VARIETY TESTS. (61*st Ann. Rept. Georgia Expt. Sta.*, 1948-49.) During the three-year period 1946-48 six varieties of cotton—namely Empire, CSS3720, Stonewilt, Coker 100 Wilt, Stonevill 2B and Deltapine—were tested each year at several locations in the State. Empire was found to lead in lint production and also in money value, with CSS3720 and Stonewilt ranking second and third respectively. The money value of Empire is $15 per acre more than for any other commercial variety tested.

Increased utilization of Empire cotton by farmers in many parts of the Cotton Belt occurred in 1948, the principal increases being reported from Georgia, various parts of the Mississippi Valley area, the lower Rio Grande Valley in Texas, and in the Matamoros District in Mexico. It is estimated that over 300,000 acres of Empire were planted in 1948, and it is expected that the total acreage exceeded 500,000 in 1949.

457. SOUTH CAROLINA: 1949 COTTON CROP. (Clemson Agric. Coll., *Ann. Rep.*, 1949.) In South Carolina the 1949 cotton crop suffered heavy damage as a result of a combination of unfavourable weather conditions. The mild winter of 1948-49 resulted in a new high-record survival and spring emergence of boll weevils, and continued rainfall during the fruiting and harvesting season made effective control very difficult throughout the State. This continued rainfall also caused heavy damage to cotton bolls from boll rot and other diseases. The combination of cotton insect and disease damage reduced the average yield of lint cotton per acre on the farms of the State from a 1944-48 five-year average production of 348 lb. per acre and a 1949 production of 372 lb. per acre to 211 lb. per acre in 1949.

458. COTTON PRODUCTION AND INSECT CONTROL IN SOUTH CAROLINA, 1950. (Clemson Agric. Coll., Sth. Carol., *Cir.* 349, February, 1950.) The importance of proper timing and thoroughness of coverage in the use of cotton insecticides during the 1949 season received the greatest emphasis. Both of these were deciding factors between profit and loss to the cotton farmer in what proved to be the most disastrous year since the infiltration of the boll weevil into South Carolina. A survey of the records of the contestants participating in the 1949 Five-Acre Cotton Improvement Contest showed that the yield per acre of lint was directly proportional to the number of applications of poison received. Sixty contestants who made 6 or more applications produced an average of 563 lb. of lint cotton on each acre. All the contestants in this survey used the BHC-DDT mixture.

The report includes a chapter on methods for using sprays, giving particulars of the necessary machinery and its adjustment for special requirements.

459. COMPARATIVE FIBRE AND SPINNING TEST RESULTS FOR SOME COTTONS GROWN IN SOUTH CAROLINA, 1949 CROP. By W. J. Wright. (U.S.D.A., Prodtn. and Marktg. Admin., Cott. Branch, May, 1950.) Fibre and spinning test results for cottons produced during the 1949 season at the Pee Dee Experiment Station, South Carolina, are summarized in this report. As this is the fourth consecutive crop year for which similar reports have been published, these results afford a basis for comparing the range in quality that may be expected from year to year for certain varieties that are common to the four crops studied. The varieties and strains included in this report are limited to those now in commercial production, and to selections that show promise of being used for commercial production in the near future. Fibrograph length, Pressley length, Micronaire fineness, microprojector maturity, and grade and staple classification tests were made on all cottons included in the report.

Although they are of primary interest to cotton breeders and others engaged in cotton-improvement programmes, these findings are also of value to cotton manufacturers and cotton-merchandising firms who must locate suitable sources of cotton for specific uses.

460. TEXAS: COTTON VARIETY TESTS IN THE EL PASO VALLEY, 1943-48. (*Texas*

Agric. Exp. Sta. Bull. 719, March, 1950.) Cotton is the principal cash crop in the El Paso Valley. It was grown on approximately 70 per cent. of the cultivated land during the 5-year period 1944-48. An abundance of irrigation water, rich alluvial soils, low rainfall, and relatively low incidence of insects and diseases are conducive to the production of high yields of superior-quality cotton. The average yield in El Paso county during these five years was approximately $1\frac{3}{4}$ bales of lint per acre. Nearly 82 per cent. of the crop was of $1\frac{3}{32}$ in. staple or longer, and 52 per cent. graded Strict Middling Extra White or better. Except for a limited acreage of American Egyptian cotton, the area is planted exclusively to Acala 1517 and related varieties.

Approximately 100 strains of cotton have been tested for yield, staple, lint percentage and other characteristics in the past eight years. The results are included in this bulletin. Acala 1517WR and Acala 1517 produced yarn-strength equivalents of more than 2·5 32nds in. above their classer's staple lengths.

461. PLANT DISEASES IN TEXAS AND THEIR CONTROL. By A. A. Dunlap. (*Texas Agric. Exp. Sta. Cir. No.* 124, December, 1949.) This is the fourth revision and reprinting of Circular 91 issued in 1941 by the Texas Agricultural Experiment Station. In the section dealing with cotton mention is made of root-rot, bacterial blight, wilt, soreshin, boll shedding and root knot. The general symptoms of each disease are described and control measures are suggested.

462. COST AND QUALITY OF COTTON GINNING IN THE LOWER RIO GRANDE VALLEY OF TEXAS. See Abstract 486.

COTTON IN EGYPT

463. EGYPT: COTTON CROP, 1949-50. (*Cotton*, M/c., 17/6/50.) The following figures are given by the Ministry of Agriculture in the third and final estimate of the 1949-50 cotton crop: Long Staple varieties (above $1\frac{3}{8}$ in.), 3,720,449 cantars from 940,647 feddans; Average Long Staple varieties (above $1\frac{1}{4}$ in.), 778,801 cantars from 159,870 feddans; Medium Staple varieties (above $1\frac{1}{8}$ in.), 4,017,957 cantars from 591,487 feddans.

464. THE EGYPTIAN COTTON CROP, 1930-50. By E. Lord. (*Egyptian Cott. Gaz.*, **10**, May, 1950, p. 1.) In this article details are given of some of the many changes which have occurred in the Egyptian crop during the past twenty years. With the exception of the Ashmouni/Zagora style of cotton, now some ninety years old, no variety grown in the 1929-30 season appears in the 1949-50 crop. A brief survey of the ever-occurring rise and fall of different varieties is made in the first portion of the account. This section is not intended to be exhaustive, but rather to serve as an introduction to the second part, in which the characteristics of the more important cottons are reviewed on the basis of the results of controlled fibre and spinning tests made at the Shirley Institute.

465. FREQUENCY OF NEPS IN YARNS OF EGYPTIAN COTTONS. By O. M. Abdelhafez. (Min. Agric. Egypt., *Tech. Bull.* 253, 1950.) An account of the nature, causes and origin of neps in cotton is given, summarizing the work of previous authors. Comparisons of the nep content of varieties were made by counting neps in successive trials of constant lengths of yarn. Diagrams and figures show that under a given set of conditions the number of neps in yarn is more or less a specific characteristic of the particular variety. Variability within a sample is shown to be positively correlated with the mean number of neps.

COTTON IN OTHER FOREIGN COUNTRIES

466. BELGIAN CONGO: COTTON CROP. (*Cott. and Genl. Econ. Rev.*, 16/6/50.) The ginning of the 1949 crop now being completed, it is possible to ascertain the production of lint, which for the first time reached 230,000 bales (478 lb.), against 187,000 in 1948. This increase is due chiefly to the high productivity of two new varieties now being grown in the Belgian Congo—Stoneville, in the Northern regions, and

Gar in the South, which replaced the old Big Boll Triumph—and also to the increase of the buying price of the seed cotton.

467. BRAZIL: COTTON CROP. (*Cotton*, M/c., 5/8/50.) A measure will probably come into force shortly which will make it obligatory for cotton-growers to uproot and burn the remains of their crops and the residues from the gins by August 15 each year. The object of the measure is to control pests, and certain penalties, including the stoppage of seed supplies for the new crop, for failure to carry out this procedure are being considered. Plans to ensure that sufficient supplies of insecticides are available to planters are also under consideration, and for this purpose financial assistance will probably be sought from the State and Federal Governments. The 1948-50 crop is now estimated at 130,000 tons.

468. TEXTILE INDUSTRY. (*Cotton*, M/c., 22/7/50.) Some of the principal textile unions have addressed a communication to President Dutra calling his attention to the precarious situation of the textile industry. There is over-production in various sectors, particularly those engaged in the spinning and weaving of cotton and jute. The home market is unable to absorb the current output, the existing surplus estimated at between 500,000 and 600,000 metres of cotton piece goods having been brought about by the sharp fall in exports. The memorandum concluded with the following recommendations: (*a*) the immediate inclusion of exports of yarn and piece goods in the barter system, and (*b*) the complete elimination from the list of imports under trade agreements with other countries of any products similar to those of the national textile industry.

469. EL SALVADOR: COTTON CROP. (*Ambassador*, July, 1950, p. 82.) The 1949-50 cotton crop in El Salvador seems to be the largest in the history of that country. Preliminary estimates give the total as about 28,000 bales, which is nearly 40 per cent. more than the 1948-49 crop, which was also a record. Cotton consumption by the mills in El Salvador has averaged about 12,000 bales annually in recent years; a Government-owned mill, at San Miguel, with a capacity consumption of 600 to 650 bales a month, is still using only about 80 bales; it is hoped that the proposed installation of new machinery during 1950 will increase the consumption figure.

The Co-operative Algonera Salvadorena made its first sale of cotton to Europe with a shipment of 6,000 bales to the United Kingdom; about 2,000 bales have been shipped to Britain on consignment. Guatemalan mills have contracted to take about 6,000 bales, and the Co-operative expects to dispose of the remaining 2,000 bales of the 1950 export surplus to either Honduras or Guatemala.

470. COTTON IN ETHIOPIA, ERITREA AND THE SOMALILANDS. By R. P. Dunn. (Nat. Cott. Coun., Tenn., January, 1950.) This report describes the trends and prospects of production of cotton and cotton textiles in Ethiopia, Eritrea and the Somalilands. Under Italian promotion, commercial cotton production reached a peak of about 17,000 bales in 1940: of this about 11,000 bales were produced in Italian Somaliland, 3,000 bales in Ethiopia and 3,000 bales in Eritrea. This production was mostly on plantation concessions. Since that time commercial production has continued to decline and now amounts to only a few thousand bales. In addition to the commercial cotton, several thousand bales have been grown for generations by the natives in these areas for hand spinning.

Further development in Italian Somaliland and Eritrea is limited, but there appear to be several million acres in Ethiopia which could be devoted to the production of Upland cotton; under supervision yields up to 150 lb. of lint per acre might be expected. The limiting factor here, however, is the sparsity of population. During the Italian occupation, cotton districts were established and gins were constructed. The best results were obtained in the Soddu districts, where in the first season about 250 bales were produced, in the second 875, and in the third about 2,300. All the cotton was of American Upland varieties—Acala, Rogers III. Stoneville 5, Coker Wilt 100, Lankart, Watson and Bagley. In some sections yields of 750 lb. of lint per acre were reached by Impresa Cotoniere Africa Italiana with Acala seed.

471. France: Institut Français de Recherches du Coton et des Textiles Exotiques. (*Egyptian Cott. Gaz.*, **10**, May, 1950, p. 47.) Cotton production in overseas French territories totals 28,000 tons, or ⅕ of France's consumption. The Institut de Recherches du Coton et des Textiles Exotiques was founded in 1946 with the aim of encouraging the production of cotton and other fibres which France urgently needed. The activities of the Institute are briefly described in this article, which concludes with a list of the cotton-research stations that have been established in French West Africa and French Equatorial Africa and the programmes of work now being carried on at these stations.

472. Greece: Cotton Industry. (*Cott. and Genl. Econ. Rev.*, 30/6/50.) Cotton consumption in Greece has been increasing due to greater demand for cotton textiles. Consumption in the first eight months (August to March, 1950) was reported at 53,900 bales (480 lb.). Consumption over the entire 1949-50 season is estimated at 90,000 bales, as compared to 80,000-85,000 bales annually for the past 3 seasons. A good crop in 1949, better security conditions, and political stability have stimulated domestic demand for cotton textiles this season.

Acreage planted to cotton this spring has been estimated at about 20 per cent. greater than last season. The increase was attributed to favourable prices received by farmers for their cotton last season, programmes for seed improvement and insect control, and the installation of modern gins. If yields average about the same as last season, a crop of about 85,000 bales can be expected. This would be slightly short of expected requirements next season. Greece imported 23,000 bales of cotton during the first 8 months of the current season, practically all from the United States.

473. Japan: Cotton Industry. (*Cotton*, M/c., 22/7/50.) General MacArthur has removed all restrictions on Japanese cotton textile production, and estimated capacity will go up 500,000 spindles a year. The present ceiling of 4,000,000 spindles is to be removed, but it is thought that unless United States aid programmes to South-East Asia enlarge Japan's markets for textiles, the Japanese will not exceed their present 4,000,000 spindles, as only about 3,500,000 are now operating.

474. Mexico: Cotton Crop. (*Cott. and Genl. Econ. Rev.*, 23/6/50.) The area planted to cotton in Mexico this year is estimated at 1,780,000 acres, representing an increase of 23 per cent. over the 1,446,000 acres reported in 1949-50 and 70 per cent. higher than the 1948-49 estimate of 1,050,000 acres. The greatest increase in 1950 has again been reported from the Matamoros-Reynosa region, where the present acreage is estimated at 791,000 acres, an increase of 28 per cent. This area represents 44·5 per cent. of the total cotton acreage in Mexico this year and accounted for more than half of the cotton exported from Mexico last year.

An estimate of 272,000 acres in the Laguna area represents an increase of 28 per cent., and 297,000 in Mexicali represents a 12 per cent. increase. The 161,000 acres planted to cotton in the States of Sonora, Sinaloa and Nayarit this year represent an increase of 55 per cent. Most of it is fertile land being cultivated for the first time in 1950 under pump irrigation.

475. Portuguese East Africa. By R. P. Dunn. (*Cotton in Southern Africa*, Nat. Cott. Coun., Tenn., January, 1950.) During the last decade Mozambique's cotton crop has increased fourfold under the stimulation of the government's price-support programme, its protective legislation, and the direction and promotion of the Cotton Export Board. Currently the production of about 130,000 bales in Mozambique, plus another 32,000 bales in Angola, provide approximately all of the total fibre requirements of the Portuguese textile industry, whereas in 1932 the colonies provided only 10 per cent. of this requirement. The production of cotton on large plantations owned by Europeans has continued to decline through the years, as the large-scale operators have found the production of other crops, particularly sugar and cocoanuts, more profitable. Whereas practically all the cotton was produced on European plantations twenty-five years ago, now less than 1 per cent. of the land planted to cotton is on the large plantations.

Over half of the cotton produced in Mozambique is an Upland type from Uganda, which was developed at the Barberton Experiment Station of the Empire Cotton Growing Corporation, established in South Africa, under the name of U.4 and introduced in Mozambique in 1929. The other types grown are all selections of the original U.4. The tremendous variation in yields, ranging from 30 to over 300 lb. of lint cotton per acre, is largely due to the erratic weather. The average yield for the country as a whole is about 65 lb. per acre. The maintenance of soil fertility is one of the most serious problems of the territory, and soil depletion is also a prime cause of low yields in cotton.

During 1948 the first cotton-spinning mill, known as Fabrica de Malhas de N.S. de Guia, owned by a Portuguese syndicate, was established near Lourenço Marques. The first weaving mill, owned by a textile group in Portugal, is being established at Vila Pery. A hydroelectric power plant with 50 per cent. government capital is being constructed as an encouragement to the industries. The spinning mill is expected to consume about 14,000 bales of cotton annually, and will use about half local and half Egyptian cotton.

476. Portuguese West Africa. By R. P. Dunn. (*Cotton in Southern Africa*, Nat. Cott. Coun., Tenn., January, 1950.) Cotton has been grown in Angola since early 1900, although production never exceeded 5,000 bales until the middle '30s. After the Colonial Cotton Export Board undertook the direction of the industry in 1938, the crop increased rapidly from the average of 6,000 bales in 1935-36 to a peak of 32,000 bales in 1943-44. The educational and promotional programmes carried on by the Board to encourage the production of cotton were undoubtedly helpful in furthering this development, but expansion appears to have been achieved primarily as a result of the strict regulations requiring planting of cotton in designated areas and the stimulation offered by the guaranteed price to the natives. There are reported to be about 24 gins in Angola. The quality of the crop is unusually high. Because of the care in picking, the system of separating the damaged locks before selling the lot, and the practice of leaving damaged cotton in the fields, about 70 per cent. of the crop is usually classified Grade I.

477. Cottonseed Industry in Portuguese West Africa. See Abstract 490.

478. Syria: Cotton Production. (*Int. Cott. Adv. Comm. Monthly Rev.*, June, 1950.) Cotton production in 1949 has been estimated at approximately 70,000 bales, which is more than double the outturn of the preceding year. Highly remunerative prices encouraged farmers to plant larger areas with cotton and weather conditions were very favourable in 1949. About 90 per cent. of the crop is of American varieties. Despite the increased requirements of its thriving textile industry, small quantities have been exported, principally to European countries.

SOIL, SOIL EROSION AND FERTILIZERS

479. Soil Conservation in the British Colonies. (*World Crops*, July, 1950, p. 305.) This article states briefly the causes of erosion and describes agricultural practices on estates and peasant small-holdings by which it is encouraged. Protective measures are listed and a short survey of the regional position in the African colonies, the West Indies, and the Mediterranean and Eastern dependencies is included.

480. Soil Conservation. By A. T. Sen. (*Indian Farming*, x, **12**, 1949, p. 525.) Although it is possible to find out the appropriate use of land from scientific consideration, the adoption of that use by Indian farmers is beset with difficulties. The present land uses in India are the results of cumulative influences of economic and social factors. In a conservation programme, therefore, due recognition should be given to the fact, and the object must be achieved through education rather than through enforcement. However, the need for drawing up a national programme of soil conservation in which the activities of governmental agencies and of farmers are to be integrated and co-ordinated is becoming urgent.

In this paper the author sets out a system for classifying the land according to its use capability and lists the conservation practices that have already been introduced. It is pointed out that these measures are not co-ordinated and are of very recent origin. The broad lines on which a national programme of soil conservation in India might be based are discussed in the light of similar programmes recently undertaken in the United States.

481. DRAINAGE AND RECLAMATION OF IRRIGATED LANDS IN PAKISTAN. By Sir Roger Thomas. (Grenich Agencies, Karachi, 1949. Price Rs. 1-8.) This report is the outcome of a study tour made by the author in the United States and Egypt under the auspices of the Pakistan Government. It is divided into three parts: Part I—Land Drainage in the United States; Part II—Land Drainage in Egypt; and Part III—Drainage Problems in West Pakistan.

The total irrigated area in the United States is about twenty million acres. These lands are widely scattered but are mostly located in the Western and South-Western States, where the rainfall is deficient. In the arid and semi-arid valleys of the United States drainage problems, most of them unforeseen, have invariably followed the introduction of irrigation. Land drainage has been, and continues to be, one of the most vexatious economic problems in this region, but much progress has been made in recent years in placing on a scientific basis the reclamation of salt and alkali lands.

At present the cultivated area in Egypt is about 6 million acres, of which about 4½ million are under perennial irrigation and the remaining 1½ million acres are basin irrigated. No drainage system was needed in Egypt until the ancient basin inundation system of cultivation was converted to controlled irrigation. The basin system, which is seasonal, needs no artificial drainage because no irrigation is given after the initial heavy watering has been applied, so that during the growing period of the crops the subsoil water-table progressively recedes and continues to do so until the next flood season.

The agricultural wealth of West Pakistan is derived mainly from irrigated lands. The total irrigated area is about 21 million acres, and the preservation of the natural fertility of these lands is of paramount importance to the continued prosperity of the State. It is estimated that about 2 million acres of irrigated land have been seriously affected with salt accumulation and that an additional 2 million acres of virgin lands are so heavily impregnated with salt as to render them uncultivable. The waterlogged lands are expanding each year. Most of the lands threatened with waterlogging have to be abandoned due to excessive salt accumulation long before the water-table reaches ground level.

482. POTASSIUM IN OKLAHOMA SOILS, AND CROP RESPONSE TO POTASH FERTILIZER. By H. J. Harper. (*Okla. Agric. Expt. Sta. Bull.* B-346, March, 1950.) This bulletin reports a study made to obtain more precise information on the location of low-potash soils in Oklahoma and the degree of the deficiency in various areas. The study also included a comparison between degree of potassium deficiency and the probable increase in yield which might reasonably be expected from applications of potash fertilizer. It is stated that when the exchangeable potassium in a soil is less than 50 parts per million, response from potash fertilizer is high. (Cotton rust usually appears on leaves of unfertilized plants grown on soils containing less than 50 parts per million of exchangeable potassium.) Response will be moderate when the exchangeable potassium is 50 to 100 parts per million, slight from 100 to 150 parts per million, and none above 150 parts per million.

483. COTTON PLANT: FERTILIZING WITH PHOSPHATES. By W. L. Nelson *et al.* (*Soil Science*, **68**, 1949, pp. 137 and 151. From *Summ. Curr. Lit.*, xxx, **8**, 1950, p. 205.) Field trials are reported on the utilization of phosphates by the cotton plant in N. Carolina. The effects of the type of phosphatic fertilizer, the age of the plant, the phosphate content of the soil and the mode of application are discussed.

484. FERTILIZER TRIALS IN THE LEEWARD ISLANDS. See Abstract 447.

STATISTICAL TREATMENT, CULTIVATION, GINNING, ETC.

485. Standardization of the Ginning Technique for Small Samples. By R. L. N. Iyengar and D. L. Sen. (*Ind. Cott. Grwg. Rev.*, iv, 1, 1950, p. 26.) This is the report of an investigation which was carried out with a view to standardizing the method of ginning small samples of kapas from cotton-breeding stations in order that the results of the ginning percentages obtained might be evenly compared. In this investigation five types of roller gins were considered, these being the types commonly used throughout India, and twelve samples of cotton comprising different botanical species were selected for trial. It was found that the ginning percentage was not affected by the size of the sample, within the limits examined, and therefore for normal ginning work 20 gm. of the sample could be considered sufficient for a test. Among the different gins Platt's hand gin with 12-in. roller was considered to be most suitable for small-scale ginning work in cotton-breeding stations.

486. Cost and Quality of Cotton Ginning in the Lower Rio Grande Valley of Texas, 1947 and 1948. By W. E. Chapman *et al.* (U.S.D.A., Prodtn. and Marktg. Admin., Cott. Branch, March, 1950.) The emergence of the Lower Rio Grande Valley as a major cotton-producing area places unusual responsibilities on the ginning industry. The rapid expansion of the area as a cotton-producing section, the increasing number of gin installations, and the necessarily short and intensive harvesting and ginning season have all increased the problems with which the ginners are confronted.

Quality and cost of ginning studies were initiated in the Lower Rio Grande Valley in 1947 and continued through 1948. The objectives of these studies were to determine the following: (1) Condition of seed cotton in relation to the quality of the ginned product, with special reference to the extent and types of equipment employed in ginning; (2) costs of operation of plants of different sizes using varying amounts of equipment; and (3) equipment and operating organization most suitable for maximum efficiency and economy for ginners and producers in the area.

COTTONSEED AND COTTONSEED PRODUCTS

487. Physical Changes in Cottonseed. (*Ann. Rep. Admin. Agric. Res.*, 1949, U.S.D.A., 1950, p. 20.) An investigation has been carried out at the Southern Regional Research Laboratory on the chemical and physical changes that occur in cottonseed as the harvesting season progresses. The information acquired will be helpful in determining the most satisfactory conditions of storage for seed harvested under various conditions.

Analyses revealed a definite relationship in the trends of several important characteristics of cottonseed taken from a gin at intervals during 1948. The contents of free fatty acids, ammonia, and free amino nitrogen all rose as the season progressed, indicating increased breakdown of both oil and protein. Seeds in which both these components have begun to break down heat more rapidly and to higher temperatures than do sound seeds, thus deteriorating to a greater extent. If the degree of breakdown in the seed is known at the time of storing the best conditions for economical handling can be selected for any particular lot of seed.

Chemical treatments similar to those that proved effective in storage of mill-scale lots of cottonseed prior to processing successfully inhibited the heating and further deterioration of all samples used in this study. Comparative germination tests on treated and untreated seeds that had been stored under identical conditions showed that the treated seeds retained viability to a greater degree.

488. Cottonseed Meal: Toxicity to Swine. (61*st Ann. Rept. Georgia Expt Sta.*, 1948-49.) Pig-feeding trials with various rations containing cottonseed meal as the protein supplement showed that young animals are susceptible to cottonseed meal poisoning. The source of carbohydrate is evidently important also, as few deaths occurred in lots fed on rations containing barley as the principal carbohydrate, while heavy losses were incurred in lots where white corn or wheat were used.

Contrary to conclusions made by another investigator years ago, cottonseed meal in the ration did not lower the oxygen-carrying capacity of the blood of pigs to a dangerous level. It also caused only a slight anæmia. Evidence was obtained which supports the opinion of Russian workers that the toxicity of cottonseed meal is largely due to its action in increasing the permeability of the capillaries and the production of hæmorrhages.

489. Cottonseed Protein Modified for Fibre and Other Non-food Uses. (*Ann. Rep. Admin. Agric. Res.*, 1949, U.S.D.A., 1950, p. 23.) Although cottonseed meals are recognized as a potential source of protein for industrial uses, the protein obtained from them in the past has been too dark for such uses. Even when the lightest-coloured cottonseed meals were treated in the usual manner for extracting protein—with an alkali to dissolve protein and after filtration with an acid to precipitate it—the product was almost black. Thus the industrial utilization of cottonseed protein was severely handicapped, while consumption of proteins from competitive sources, particularly soy-beans, rose steadily during recent years.

In 1948 the Southern Regional Research Laboratory developed a process that promises to remedy this situation. By washing cottonseed meal with weak hydrochloric acid, extracting the protein with a sodium chloride solution, and precipitating it with dilute sulphuric acid, a protein pale enough for industrial uses was obtained. In addition, ways were devised for stabilizing the protein by the addition of certain reducing sugars. These make possible the preparation of concentrated protein solutions with " working life " long enough to permit their use in adhesives, sizes, coatings and fibres.

Even when its colour and keeping quality were satisfactory, however, cottonseed protein was found to be unsuitable for spinning in its natural state because of its tendency to jell or lump. After considerable study the Southern Laboratory discovered that treatment with acid would change the structure of the protein so that it could be spun by the methods generally used in spinning other protein fibres. In 1948 enough fibre was prepared from acid-treated cottonseed protein to determine some of its properties. It has a yellow to light-orange colour, feels soft to the hands and has good dyeing characteristics. When dry it is about three-fourths as strong as wool and when wet it retains about 40 per cent. of its dry strength.

490. Portuguese West Africa: Cottonseed Industry in Angola. By A. T. Lopes. (*Agronomia Angolana*, **2**, 1949, p. 139.) The article opens with a brief review of the scope of the oil-seed industry in the Colony. In view of the expansion of cotton-growing, the author gives special attention to the utilization of cottonseed and recommends the establishment of a processing factory in Angola. Tables are given showing the amount of cotton produced over the past eight years and estimates of the relative amounts of linters, hulls, oil and oil-cake.

491. Cottonseed Oil Mill in the Sudan. See Abstract 439.

492. Cottonseed Industry in Uganda. See Abstract 444.

MACHINERY

493. Cleaning Mechanically Harvested Cotton. By H. P. Smith *et al.* (*Texas Agric. Exp. Sta. Bull.* 720, March, 1950.) For many years cotton-growers in the High Plains area have found that cotton harvested late in the season contained an excessive amount of foreign matter, and that the quality of the cotton was much lower than that of cotton harvested early in the season. This bulletin gives the results of a study conducted at Lubbock and College Station to determine the amounts of different kinds of foreign matter removed in the extracting, cleaning, ginning and spinning of cotton mechanically stripped and mechanically picked at early, mid-season and late dates.

Several varieties of cotton with different fibre qualities were harvested with strippers, designated as Nos. 15 and 16 machines, and with a spindle-type picker. At Lubbock the stems in late-harvested cotton increased 175 per cent. and the dirt and sand increased 209 per cent. over early-harvested cotton when the No. 15 stripper was used. Where the cotton stripper was equipped with a tractor-mounted field extractor, termed the No. 16 machine, the total foreign matter removed averaged less than half the amount removed from cotton stripped with the No. 15 machine without an extractor. Higher percentages of foreign matter were removed by the cleaner from the normal boll than from the storm-proof types of cotton.

At both Lubbock and College Station the strength of 22 yarn in all but one of the varieties became weaker as the harvest was made later. The yarn from the storm-proof strain CA 89A became stronger as the harvest was delayed.

PESTS, DISEASES AND INJURIES, AND THEIR CONTROL

494. Desert Locust Migrations and Synoptic Meteorology in the Gulf of Aden Area. By R. C. Rainey and Z. Waloff. (*J. Anim. Ecol.*, **17**, 2, 1948, p. 101. From *Rev. App. Entom.*, **38**, 6, 1950, p. 227.) The meteorological data relating to a number of swarm movements of *Schistocerca gregaria*, Forsk., recorded in the Gulf of Aden between 1941 and 1947 have been examined, using the corresponding synoptic charts. The trajectory of the air in which a flying swarm is observed, considered in relation to recent determinations of the air-speed of *Schistocerca*, is shown to provide evidence of the origin and destination of the swarm, affording, in favourable circumstances, a good indication of its probable track, and making possible some deductions as to the course or orientation of the locusts.

Trajectories relating to swarms arriving on the coast of British Somaliland during the winter indicate the migration of swarms of the monsoon generation across the Gulf of Aden from the Hadhramaut. Records of swarms reaching Aden and the adjacent coast in summer give trajectories indicating the migration of swarms of the long-rains generation from Western British Somaliland, also across the gulf. It appears probable that locusts of phases *transiens* and *solitaria* may similarly migrate across the gulf. Swarms landing on the coasts of the Somali peninsula during the summer are shown to be probably mainly of local origin, swept out to sea by the monsoon and subsequently brought in again by the sea breeze. An alternative possibility in some of these cases is that of transportation across the gulf by the north-easterlies that overlie the south-west monsoon and are probably continuous with the surface north-westerlies of Arabia at this season.

495. Locust Threat to Kenya. See Abstract 427.

496. Locust Invasion in the Sudan. See Abstract 440.

497. Cotton Insect Control with New Organic Insecticides in Mexico. By I. Moreno. (*J. Econ. Entom.*, **42**, 3, 1949, p. 484. From *Rev. App. Entom.*, **38**, 6, 1950, p. 241.) For several years farmers in the La Laguna district of Mexico, one of the principal cotton- and wheat-growing areas in the country, have been trying to grow both crops each year on the same land; but although cotton planted in late June, soon after the wheat harvest, produces good stands of seedlings with fast growth and satisfactory production of fruits, the fields serve as a trap crop for insects that develop in the regular cotton fields planted in March and April and become so heavily infested that no cotton can be picked.

Field investigations were therefore carried out in 1948 to see whether insecticides would give satisfactory control. The most important pests in the district are *Platyedra* (*Pectinophora*) *gossypiella*, Saund., *Heliothis armigera*, Hb., a Pentatomid of the genus *Chlorochroa*, *Aphis gossypii*, Glov., and *Anthonomus grandis*, Boh. Field examinations of cotton planted on June 24 showed that 20 per cent. of the squares were punctured by *A. grandis* on August 17, and applications of 15 lb. per acre of a dust mixture containing 2 per cent. γ BHC (benzene hexachloride) and 10 per cent. DDT were made weekly from that time. These controlled the weevil until August 31, although it still increased on untreated plots, but heavy rains during early September then prevented treatment. When the soil was dry enough for further collection of squares, plant growth was so dense and weevil infestation so heavy that treatment with a dust containing 6 per cent. γ BHC from an aeroplane was substituted. This reduced the weevil, but after three applications, on September 23 and 28 and October 3, infestation of bolls by *P. gossypiella*, which, like *Heliothis*, had hitherto been unimportant, increased to 33 per cent., and applications of the mixture at seven-day intervals were therefore renewed and continued until October 26. These prevented any further increase of *P. gossypiella* for the season, and the weevil continued to decrease. Aphids practically disappeared from the treated plot after the first application of DDT and BHC, but became so numerous on the controls that they stunted the plants and caused heavy damage to the crop. It was impossible to distinguish boll damage by *Anthonomus*, *Platyedra* or the Pentatomid on the untreated plot owing to the extremely heavy total infestation.

During the first fortnight of November a frost killed all the leaves, young bolls and terminal buds, destroying about 30 per cent. of the crop, and on November 16 cotton was picked for the first time from the treated plot. The yield averaged 880 lb. seed cotton per acre, whereas no bolls in the untreated plot were worth picking.

It is concluded that planting cotton late in the season is unprofitable. Although insect pests can be controlled, the high populations make it necessary to apply insecticides twice as often as in normally planted cotton fields and early frosts may so reduce the yield that the final crop will not pay for the cost of insecticides or cultivation.

498. COMPARISON OF CALCIUM ARSENATES ALONE AND MIXED WITH ORGANIC INSECTICIDES FOR COTTON INSECT CONTROL. By J. S. Roussel and J. C. Gaines. (*J. Econ. Entom.*, **42**, 3, 1949, p. 551. From *Rev. App. Entom.*, **38**, 6, 1950, p. 254.) The results are given of tests in a dusting tower at College Station, Texas, to compare a special calcium arsenate, containing 33·2 per cent. total arsenic, 6·7 per cent. water-soluble arsenic and no free lime, with commercial calcium arsenate, containing 28·1 per cent. total arsenic, 0·14 per cent. water-soluble arsenic and 16·8 per cent. free lime, against *Anthonomus grandis*, Boh., and mixtures of BHC (benzene hexachloride) or parathion with the special calcium arsenate against *Aphis gossypii*, Glov. Previous work had shown that BHC is incompatible with some forms of calcium arsenate. In the tests against the weevil the median lethal dosages in lb. per acre were 5·07 for commercial calcium arsenate and 4·95 for the special calcium arsenate. In tests against the *Aphis*, in which fresh mixtures of the latter with 0·5 per cent. γ BHC or 0·1 per cent. parathion were applied to infested cotton leaves (and these were kept at 85°F. and 70 per cent. relative humidity for 24 hours before mortality was estimated), the median lethal dosages in lb. per acre were 9·33 and 2·97 respectively.

499. EFFECT OF TEMPERATURE AND HUMIDITY ON THE TOXICITY OF CERTAIN INSECTICIDES. By J. C. Gaines and H. A. Dean. (*J. Econ. Entom.*, **42**, 3, 1949, p. 429. From *Rev. App. Entom.*, **38**, 6, 1950, p. 235.) Cage tests were carried out in Texas to determine the effect of temperature and humidity on the toxicity of several insecticides to *Anthonomus grandis*, Boh., on cotton plants. The insecticides used were 20 per cent. toxaphene in sulphur, calcium arsenate, 3 per cent. BHC (benzene hexachloride) with 5 per cent. DDT in sulphur, and 10 per cent. chlordan in sulphur. It was concluded that temperature and humidity affected calcium arsenate less than the organic compounds and toxaphene less than the other organic compounds, though the toxicity of both calcium arsenate and toxaphene was reduced by high temperature or high humidity, and that laboratory-reared weevils were considerably more susceptible than field-collected ones to the organic insecticides.

500. FACTORS INFLUENCING THE ACTION OF DUST INSECTICIDES. By W. A. L. David and B.O.C. Gardiner. (*Bull. Entom. Res.*, **41**, 1, 1950, p. 1.) The methods used to investigate the properties of dusts are described and the relevance of the various physical properties to insecticidal action are considered. In problems relating to the adherence of the dusts to insects, the actual quantity of dust was measured either by weighing the insects before and after dusting or by dyeing the dust with Sudan III and determining the quantity colorimetrically. The experiments were all conducted under known conditions of temperature and humidity.

Non-toxic dusts killed insects by causing them to lose water. Not all non-toxic powders were equally effective when conditioned to the same relative humidity. All were without effect at saturated humidity and became progressively more rapid in action as the humidity at which the test was carried out was decreased. The non-toxic dusts caused the insects to lose water by abrading certain areas of the cuticle. To be effective as an abrasive the dust must be hard, finely ground and sharply angular. Presumably the coarser materials cannot gain access to the articulations where abrasion usually occurs. Moreover, insects eat the small particles of a powder more readily than the large particles, and it was observed that the quantity in the gut became less as the particle size increased.

The effect of adding DDT to a dust on the rate of its action on insects depends upon the abrasiveness of the dust and the humidity of the environment. At saturated humidity DDT increased the effectiveness of all non-toxic dusts since they themselves were entirely inactive. Abrasive dusts were more effective carriers for DDT than non-abrasive dusts because the lethal effects of desiccation were added to those of the DDT. There was no evidence that abrasive dusts facilitated the entry of DDT or rotenone into insects as a result of the damage caused to the cuticle.

501. Grasshopper Control with Chemical Sprays and Dusts. By C. H. Brett *et al.* (*Okla. Agric. Expt. Sta. Bull.* B-351, June, 1950.) During the past few years many new chemicals have been developed, some of which are very poisonous to grasshoppers. These have been studied continuously to determine conditions and methods for applying them with greatest efficiency. Results of tests reported in this bulletin are summarized briefly as follows:

DDT is not a satisfactory grasshopper poison using quantities which would be practical and economical in Oklahoma. Insecticides which gave the most effective control as sprays are chlordane, 1·0-1·5 lb. per acre; toxaphene, 1·5-2·0 lb. per acre; and parathion, 0·2-0·3 lb. per acre of the actual insecticidal material. The most effective control was obtained by spraying these on succulent plants during May, when the nymphs have nearly all hatched and are feeding. As the season progresses, costs increase and control decreases. Benzene hexachloride is most satisfactory when applied as a dust at the rate of 0·5-0·6 lb. of the gamma isomer per acre. Compared with other materials, it is especially useful later in the season when temperatures are high and most grasshoppers have reached the adult stage.

Plants sprayed or dusted with these insecticides remained poisonous to grasshoppers feeding on them as follows: parathion about two days, toxaphene and gamma benzene hexachloride less than one week, chlordane and aldrin between one and two weeks, and dieldrin between two and three weeks.

502. A Suction Trap for Small Airborne Insects which Automatically Segregates the Catch into Successive Hourly Samples. By C. G. Johnson. (*Annals of App. Biol.*, 37, 1, 1950, p. 80.) This paper describes the design and operation of a suction trap which takes in air at a constant rate in winds up to 12 m.p.h. The catch is deposited in a collecting tube into which closely fitting disks fall, one every hour, thus segregating the catch into successive hourly samples.

Apart from any increased accuracy in estimating insect density which the trap may possess, it has some practical advantages over other types of trap. It is clean to use and will work well in any weather. The smaller insects for which it was designed are in excellent condition for preservation and identification. It is particularly suited for work in very calm air and probably in confined spaces where other traps may not be suitable. It does not depend primarily on any response of the insects for its catching power. Its greatest disadvantage may be the necessity for a supply of electricity.

503. The Comparison of Suction Trap, Sticky Trap and Tow-net for the Quantitative Sampling of Small Airborne Insects. By C. G. Johnson. (*Annals of App. Biol.*, **37**, 2, 1950, p. 268.) The performances of the three traps in the field operating over a range of wind speeds are described. Particular attention has been paid to Aphids, for which the sticky trap and tow-net are generally used and for which the suction trap was primarily designed. Density estimates of these insects in winds below about 3 m.p.h. are much larger when calculated from suction trap catches as compared with estimates from sticky-trap and tow-net catches. There is reason for the belief that the suction trap is neither attractive nor repellent to Aphids to a significant extent, and that it catches these insects at random by virtue of its air stream alone; weighting of catches due to variable quantities of air being sampled does not occur. It is considered, therefore, that the suction-trap values of density are likely to be the more accurate ones.

504. Report on Plant Virus Classification and Nomenclature. (*Annals of App. Biol.*, **37**, 2, 1950, p. 329.) The committee appointed to consider the existing systems of nomenclature and classification of plant viruses and to recommend which system would be best suited for Great Britain have made the following recommendations:

(1) That until a system of naming viruses has been adopted at an International Botanical or Microbiological Congress, virus workers in Great Britain should continue to use the old-established method of referring to plant viruses by the descriptive names of the diseases they cause with the "virus" added (*e.g.*, tobacco necrosis virus, potato leaf roll virus, etc.), and that virus strains be designated in a similar way (*e.g.*, tobacco mosaic virus, enation strain).

(2) That to give uniformity, and pending a decision on nomenclature by an International Congress, virus workers should use, when possible, the names in the *List of Common Names of Virus Diseases used in the Review of Applied Mycology*, published in 1946 by the Commonwealth Mycological Institute.

(3) That supplements or revisions of this list should be published at intervals, based on revisions by specialists in particular groups. It should be considered what body is most appropriate for issuing such lists of revisions; the work may best be done by some inter-society group or international committee.

(4) That to leave a clear field for establishing a system of classification and nomenclature of the viruses when knowledge has increased sufficiently, virus workers in Great Britain should refrain from using Holmes's scheme, which we consider fundamentally unsound, both in the misleading groupings it contains and in its premature application of Linnæan binomial nomenclature to viruses.

505. Manual of Bacterial Plant Diseases. By W. J. Dowson. (London, A. and C. Black Ltd., 1949. Price 16s. From *Rev. App. Mycol.*, xxix, **5**, 1950, p. 252.) This comprehensive text-book contains information for the identification of bacterial plant pathogens for the benefit of students of plant pathology, and for workers concerned with diagnosing plant diseases and advocating control measures. The author deals with the nomenclature and classification of the bacteria concerned and gives some of the results of recent investigations made by himself and his research workers. All the known diseases occurring in Britain and those most important in the Dominions, Colonies and Dependencies are included, the account of each disease concluding with references to the more important and recent investigations.

506. The Genetics of Blackarm Resistance: VIII—*Gossypium barbadense*. See Abstract 517.

507. The Evolution of Blackarm Resistance in Cotton. See Abstract 516.

508. Response of Cotton to Leaf-curl Disease. By J. B. Hutchinson, R. L. Knight and E. O. Pearson, (*J. Genetics*, **50**, 1, 1950, p. 100.) Leaf curl is an extremely serious disease of Egyptian cotton and of *bamia* (*Hibiscus esculentus*) in the Sudan. A survey was made of the response to the disease of 671 strains of cotton. *Gossypium arboreum* and *G. herbaceum* are effectively immune, and *G.*

hirsutum and its vars. *punctatum* and *marie-galante* highly resistant, but *G. barbadense* contains a large proportion of susceptible strains.

Evidence is presented for the belief that the disease reached the Sudan from West Africa through a chain of host plants across the north equatorial region, and that its spread within the Sudan from one major cotton area to another was in the main along the riverain crops of *bamia.* The variability of leaf-curl symptoms in West Africa as compared with the Sudan indicates that several virus strains may be involved.

A large proportion of the cottons possess resistance that cannot have been developed under the selective impact of the disease, and it is shown that the breeding of resistant types has been accomplished repeatedly by the accumulation of minor genes by selection. It is suggested that leaf curl is not specific to cotton, and that even in susceptible varieties little change in the genotype is needed to give virtual immunity.

509. *Oidiopsis gossypii* (Wakef.) Raychaudhuri f. *indica* f. nov. ON COTTON. By S. P. Raychaudhuri, (*Trans. Brit. Mycol. Soc.*, **32**, 3-4, 1949, p. 288. From *Rev. App. Mycol.*, xxix, **6**, 1950, p. 302.) The name proposed for the conidial state of a powdery mildew, which affected about 11 per cent. of the cotton plants at Dacca in December, 1941, is *Oidiopsis gossypii* (Wakef.) Raychaudhuri f. *indica* n. form. It has shorter and broader conidia than the species described by Miss E. M. Wakefield as *Ovulariopsis gossypii* and which, at her suggestion, is transferred by the author as *Oidiopsis gossypii* n. comb.

510. STUDIES ON THE GERMINATION OF THE SEEDS OF *Striga hermonthica*. I.—THE INFLUENCE OF MOISTURE-TREATMENT, STIMULANT-DILUTION, AND AFTER-RIPENING ON GERMINATION. By K. B. Vallance. (*Ann. Botany*, xiv, **55**, 1950, p. 347.) It has been known for many years that the optimum germination of the seeds of some angiospermous root parasites will only take place in the presence of some stimulant exuded from the roots of suitable host plants. The effects of moisture-treatment and stimulant-dilution on the germination of the seeds of root parasites *Orobanche speciosa* and *Striga lutea* have been investigated by Chabrolin (1938) and Brown and Edwards (1944, 1946) respectively. These workers showed that if the seeds of these root parasites were exposed to moisture, prior to the application of a suitable stimulating solution, the rate of germination was enhanced, and also that, as moisture-treatment was extended, a stage was reached at which the stimulating solution could be diluted 1,000 times without significantly affecting germination.

The present paper relates to an investigation of the effects of moisture-treatment and stimulant-dilution on the germination of the hemi-parasite *Striga hermonthica.* It was thought best, however, to consider these effects in relation to the possibility that the seeds might require after-ripening in dry storage. In this latter respect the present investigation differs from those of earlier workers.

511. EFFECT OF MODIFIED CULTURAL PRACTICES ON *Verticillium* WILT OF COTTON. By P. J. Leyendecker. (*Iowa St. Coll. J. Sci.*, 24, **1**, 1949, p. 73. From *Rev. App. Mycol.*, xxix, **6**, 1950, p. 302.) The effects of soil moisture and temperature, different crop sequences, and fallow treatment on the severity of *Verticillium* wilt (*V. albo-atrum*) of cotton were studied in greenhouse and field experiments at the New Mexico College of Agriculture and Mechanic Arts over a three-year period. The field tests were made where cotton had been grown for a minimum of five years. Variety Acala 2815 was used in all tests.

Wilt was most severe in a flat, relatively cool (21°C.) seed bed and less prevalent in one raised 15 in. (28°C.). Plants in an infrequently watered spot (15 acre in.; four irrigations) were stunted and they often wilted during midday heat but had only 32 per cent. infection compared with 48 in the same field with 30 acre in. water added. Under greenhouse conditions plants in steamed compost at 25 and 50 per cent. of the water-holding capacity were stunted and much smaller than those held at 50, 70 and 85 per cent. moisture.

Infection was observed over a soil moisture range between 25 and 85 per cent.

There was very little foliage injury at 25 and 40 per cent. but progressively more at 55 and 70. In a series of irrigated and dry fallow plots established in a field in which there were 75 to 85 per cent. infection the previous season, it was found that the pathogen did not disappear from soils that were moist and fallowed for one year, but severity of infection was reduced and yield increased in dry fallow areas. Less disease was evident when cotton was sown in a severely infected field after cropping with cantaloupe, sour clover, sweet clover or lucerne than after cotton.

GENERAL BOTANY, BREEDING, ETC.

512. PROGRESS REPORTS FROM EXPERIMENT STATIONS, 1948-49. (Published by the Empire Cotton Growing Corporation, 1950. Price 3s. post free.) Progress Reports are included summarizing the work carried out during the 1948-49 season at the experiment stations in South Africa, Uganda, the Sudan, Tanganyika Territory, Nyasaland, Southern Rhodesia, Nigeria, the West Indies and Queensland. The reports on the work in Queensland, Nigeria, Southern Rhodesia, Uganda and the Leeward and Windward Islands of the West Indies are included by courtesy of their respective Governments. The volume also contains a report covering the interim period between the closing of the Trinidad Research Station in 1944 and the retirement of Mr. F. R. Parnell from the directorship of the new Central Research Station at Namulonge, Uganda, in 1949. During this period the continuity of the Trinidad genetics work was maintained on a limited scale at Shambat in the Sudan. In consequence of the Corporation's decision to hand over the Barberton Station to the Union Government and transfer their staff to the Namulonge Station, the programme of work carried out in South Africa in the 1948-49 season was much reduced. Work on yield improvement in the BP.52 stock was continued in Uganda and in the blackarm resistant strains in the Sudan. In spite of the severe drought in Nyasaland, the resisting capacity of cotton made it possible to obtain some useful results from trials conducted at the Domira Bay Station. In Nigeria an extensive survey of insect pest damage to cotton was carried out. Crop rotation experiments, manurial trials and soil fertility investigations were continued in the West Indies.

These reports should prove of much interest and value to those concerned with the cultivation of cotton and similar crops.

513. THE INHERITANCE OF AGRICULTURAL CHARACTERS IN THREE INTER-STRAIN CROSSES IN COTTON. By G. K. Govande and N. V. Joshi. (*Ind. Cott. Grwg. Rev.*, iv, **1**, 1950, p. 46.) This investigation was undertaken in order to study the genetics of quantitative characters in three inter-strains of *Gossypium arboreum*—namely, Cocanada 45, N6 Multiple recessive and A8 Burma lacinated. Parents, F_1s of A8 × C45 and C45 × N6, and their F_2s were grown in a randomized replicated experiment. Analyses of variance were carried out on plot values, when strong heterosis was demonstrated in all the three characters considered—namely, ginning percentage, staple length and node number—the F_1 differing significantly from the mean of the parent. In ginning percentage and staple length the bias was towards a higher value, while in node number it was reduced.

514. 1-NAPHTHALENE-ACETIC ACID AND 1-NAPHTHALENE-ACETAMIDE: EFFECT ON COTTON PLANT DEVELOPMENT. By S. Singh and V. A. Greulach. (*Amer. J. Bot.*, **36**, 1949, p. 646. From *Summ. Curr. Lit.*, xxx, **12**, 1950, p. 316.) Plants of Stoneville 2B cotton in a greenhouse were sprayed with various concentrations of 1-naphthalene-acetic acid and 1-naphthalene-acetamide when 57 days old and again when 71 days old. The former produced the more marked effect. The first application of 1-naphthalene-acetic acid produced strong epinastic effects. Growth of both the main stem and the fruiting branches was inhibited. The treatments did not influence area per leaf, but as a result of a decrease in the number of nodes on the branches there was a reduction in the number of leaves per plant. Leaf weight per unit area and per plant increased with the concentration of the growth substances, and the treated plants had thicker, darker green and more leathery leaves, which wilted less easily. Total dry weight of the plants was not affected, and the total dry weight of the reproductive organs was reduced only by treatment with a high concentration of the growth substance.

The treatments decreased the number of flowers per plant, but there was no great difference in the number of mature bolls per plant, so the percentage of boll set was higher in the treated plants. The final yield of seed cotton per plant was not affected significantly by any treatment. The treatments increased the weight per seed and the number of motes per boll, but the number of seeds per boll decreased in proportion. The treatments did not significantly influence the boll shed period, boll maturation period, weight of seed cotton per boll, lint index, or the tensile strength, length, or uniformity ratio of the fibres.

515. PHYSIOLOGICAL COMPARISON OF AMERICAN COTTON PLANT IN THE PUNJAB AND SIND. By R. H. Dastur. (*Ind. Cott. Grwg. Rev.*, iv, **1**, 1950, p. 1.) A physiological comparison of the growth of the American cotton plant in South Sind and in the Punjab has been made to determine the effect of small differences in the climatic conditions existing between the two tracts on the various characters of the plants. Five varieties, two Sind-American and three Punjab-American, were grown on four different sowing dates at two centres in South Sind and at one centre in the Punjab. The following important differences were found to exist in the growth of American cottons between the two tracts: (1) There was an earlier initiation of the fruiting branch in Sind than in the Punjab; (2) the square period was shorter by six days in Sind than in the Punjab; (3) the flowering was gradual in Sind and rapid in the Punjab, where it occurred in a flush (as the total number of flowers produced per plant in the two tracts was the same, the duration of flowering period was longer by 1½ months in Sind than in the Punjab); (4) the setting percentage of flowers into bolls was greater in Sind than in the Punjab; (5) the relative growth rate of the American cotton plant was higher in Sind than in the Punjab, especially during the reproductive phase. It is thought possible that the differences in the relative day and night lengths in the two tracts during the growing season may be associated with the rapid rate of development in Sind.

516. THE EVOLUTION OF BLACKARM RESISTANCE IN COTTON. By R. L. Knight and J. B. Hutchinson. (*J. Genetics*, **50**, 1, 1950, p. 36.) Blackarm (*Xanthomonas malvacearum*) has spread widely in the last few centuries with the great increase in the world's cotton crops, and is an important disease in many producing areas. Many cottons are resistant, and the nature of this resistance, its origins and the means by which it has spread are of considerable interest to the geneticist and of great importance to the plant breeder. Studies of resistance were undertaken in the belief that an economical and effective solution of the breeding problem was possible only on a foundation of genetic knowledge. These studies were made at Shambat in the Sudan on a relatively limited collection of material. An extensive collection of the world's cottons was maintained at the Empire Cotton Growing Corporation's Cotton Research Station in Trinidad, and in 1944 this collection was transferred to Shambat. This great expansion in the range of material available made it possible to combine the knowledge of major resistance genes with data on their distribution so as to give a coherent account of the origin and evolution of resistance in the world's cottons.

India is the major centre of blackarm resistance. The Indian races of *Gossypium arboreum* and *G. herbaceum* are, almost without exception, immune. Immunity and high resistance predominate in the commercial Asiatic cottons of the surrounding countries, but the general level of resistance is lower in the more peripheral areas and in perennial types. In the New World, resistance occurs in variable material at the centre of origin in Central America and in the *punctatums* of the Bahamas region, but only two resistant strains have been discovered in the main bulk of the commercial Uplands. In the *hirsutums* acclimatized in the Old World, marked resistance is common in the Uplands and *punctatums* of India and Africa. The highest degree of resistance so far recorded in New World cottons is to be found among the *punctatums* of the West African savannahs. Resistance is rare in *G. barbadense.* Minor gene resistance occurs in Sea Island, but apart from cases directly attributable to introgressive hybridization, major gene resistance had been recorded only once in the species.

Two types of resistance genes have been recognized: those which have no demonstrable effect on the plant, apart from conferring resistance, and those which affect the plant in other ways and only incidentally confer or enhance blackarm resistance. All the worth-while major resistance genes belong to the former group. There have been two great waves of spread of resistance in the commercial cottons, one in the Asiatic species and one in those of the New World. The Asiatic species acquired resistance first, and it was built up in India by the establishment of B_4 throughout the crop and the accumulation of minor genes around it. In New World cottons, resistance genes have spread from extremely limited sources. Every case of effective resistance that has been studied save one can be traced to B_2 or B_3 from *G. hirsutum* var. *punctatum,* sometimes fortified by minor genes. In addition the gene B_5 has been recorded once in *G. barbadense.*

The Upland crops of India and Africa were established on susceptible types from the U.S. Cotton Belt, but in India and West Africa resistance was acquired, by introgressive hybridization, from *punctatum.* The resistance which occurs in other parts of Africa probably traces its origin to chance hybridization with an early importation of acclimatized Indian Upland.

The foundation of effective resistance has proved to be a major gene in all the cottons tested. The value of minor genes alone is strictly limited, but wherever there has been prolonged selection under epidemic attack the main gene has been fortified by lesser genes. Effective resistance can, in fact, be built only around a main gene.

517. THE GENETICS OF BLACKARM RESISTANCE. VIII: *Gossypium barbadense.* By R. L. Knight. (*J. Genetics,* **50,** 1, 1950, p. 67.) This investigation of the genetic nature of resistance to *Xanthomonas malvacearum* in *Gossypium barbadense* is complementary to previously published studies of resistance in other species of cotton (Knight and Clouston, 1939; Knight, 1944, 1947, 1948*a*, 1948*b*). In this series of papers an account is given of the method of testing for resistance, and the existence of four major resistance genes, B_1, B_2, B_3 and B_4, and a group of minor genes is demonstrated. This paper gives an account of the behaviour of a fifth major gene, B_5, found in perennial *G. barbadense,* and of a minor gene group common in the annual Sea Island form of the same species.

518. THE GENETICS OF "CORKY." II: FURTHER STUDIES ON ITS GENETIC BASIS IN RELATION TO THE GENERAL PROBLEM OF INTERSPECIFIC ISOLATING MECHANISMS. By S. G. Stephens. (*J. Genetics,* **50,** 1, 1950, p. 9.) The work described in this paper was initiated at the Empire Cotton Growing Corporation's Research Station, Trinidad, in 1944. It was shown in Part I (Stephens, 1946) that the production of abnormal Corky hybrids in certain interspecific crosses of New World cottons could be interpreted by the complementary interaction of two alleles—$\mathbf{ck}^{\mathbf{x}}$ carried by strains of *Gossypium hirsutum* var. *marie-galante* Hutchinson, and $\mathbf{ck}^{\mathbf{y}}$ carried by strains of *G. barbadense* L. Other strains of both species are known which were presumed to carry a third (normal) allele, **ck**. It was found that $\mathbf{ck}^{\mathbf{x}}$ and $\mathbf{ck}^{\mathbf{y}}$ occur most frequently in strains of *marie-galante* and *barbadense* respectively which are grown together in mixed cultivation, and an explanation was advanced which was based on the probable effect of seed selection by man on the composition of a partly outcrossed population.

The incomplete data presented in Part II confirm earlier work in showing that genes at one locus, rather than genes at two loci in different chromosomes (Harland, 1939*a*), are responsible for the expression of Corky. They do not, however, rule out the possibility that the Corky locus is a complex of several closely linked units —*i.e.*, that **ck** alleles are in reality pseudo-alleles. Further, a comparison of the Corky case with similar cases in *Cripis* (Hollingshead, 1930), in Asiatic cottons

(Hutchinson, 1932) and in *Triticum/Ægilops* hybrids (Sears, 1944) suggests a different though equally plausible interpretation of these authors' results.

(*Cf.* Abstract 179, Vol. XXIII, No. 1 of this Review.)

519. ASIATIC COTTONS: ANTHOCYANIN PIGMENTATION. By S. G. Stephens. (*Genetics,* **33**, 1948, pp. 191 and 630. From *J. Text. Inst.,* **41**, 5, 1950, p. A264.) The pseudo-allelic series for the anthocyanin pigmentation in Asiatic cottons depends upon the interaction of at least three neighbouring loci. One, *G*, determines the presence or absence of a spot at the base of the petal, and another locus, *S*, determines the pigmentation of the spot when developed. When *G* and *S* are both present there is a red spot; *G* alone leads to a white spot. There is chemical evidence that the precursor of the pigment is a leuco compound, and it appears that the two genes condition reduction processes and act on very similar though not identical substances, anthozanthin and the leuco substance.

520. RESEARCH GAINS IN AMERICAN COTTON. By S. R. Sayre. (*Int. Cott. Adv. Comm. Monthly Rev.,* March, 1950.) Added strengths, exceeding current commercial American Upland varieties by as much as 75 per cent., are an outstanding feature of the new experimental cottons grown by American geneticists and plant breeders. The new strains reflect a shift emphasis in breeding objectives from fibre length to fibre strength as a result of annual laboratory appraisals of cotton-breeding materials. Evidence that extreme increases in fibre length and fineness add to neppiness or imperfections in yarns and to spinning costs prompted the change towards fibre strength for enhancement of the product use value of cotton yarns.

One of the new cottons, AHA 6-1-4, is a hybrid of Acala and Hopi—a primitive cotton cultivated by the Indians. High heritable fibre strength, a good length uniformity, small fibre perimeter and outstanding cell-wall thickness have been stabilized in this new strain. AHA 6-1-4 cotton staples about $1\frac{3}{32}$ in. It is now through the seventh inbred generation and retains much of the wilt and nematode resistance of the primitive parent. It is expected that 165 acres of this new cotton will be grown in 1950-51. When tested in comparison with Karnak, AHA 6-1-4 showed a yarn strength 90 per cent. as high and better yarn appearance and grade. Pressley fibre strength indexes for AHA 6-1-4 from California areas approximate 9·25 compared with indexes of 6·75 and 7·75, the usual range for the most important American Upland varieties now in commercial production.

Less far advanced are new triple hybrid segregates. These represent a synthetic hybrid of American Upland cotton, Asiatic cotton and Thurberi. The cross was produced by the late Dr. J. O. Beasley and Dr. Thomas Kerr. Spinning tests from the 1949 production of these experimental cottons show yarn count strength tests more than 50 per cent. above the average for commercial Upland cottons of the same staple length.

Two new American-Egyptian cottons, Pima 32 and Amsak, now in commercial production, are superior in spinning quality to S × P and give profitable yields.

521. MOTE TYPES IN COTTON AND THEIR OCCURRENCE AS RELATED TO VARIETY, ENVIRONMENT, POSITION IN LOCK, LOCK SIZE AND NUMBER OF LOCKS PER BOLL. By N. L. Pearson. (*U.S.D.A. Tech. Bull. No.* 1,000, November, 1949.) In the classification presented the motes are divided into two groups, (1) those whose formation is obviously due to the action of insects and micro-organisms and (2) those whose formation is probably due to the effect of genetic and environmental factors. It is the latter group with which this bulletin is primarily concerned.

Motes were counted in many samples to establish the extent to which mote formation might be related to variety, environment (location and year of growth and date of bloom), position in the lock, number of potential seeds per lock and number of locks per boll. There were found to be significant differences in the relative numbers of both small and large motes in samples representing different varieties and environments. In general, the influence of environment as represented by place and year of growth was shown to be a much more important factor in mote formation than the influence of variety, though for the most part varieties tended to retain about the same rank no matter where or when grown. Seasonal factors as represented by differences from year to year were more important than locational ones in their influence upon the number of large motes produced; the reverse was true for small motes.

522. SIZES AND DENSITIES OF SEEDS SOWN, AND THEIR EFFECT ON VIGOUR AND YIELD IN COTTON. By D. Ganesan. (*Ind. Cott. Grwg. Rev.*, iv, 1, 1950, p. 37.) The advantages of sowing selected larger and heavier seeds for improving crop yield have been known for a long time, and in 1941-42 experiments were started at the Institute of Plant Industry, Indore, with Upland (*hirsutum*) and *desi* (*arboreum*) varieties of cotton in order to estimate these advantages. Two mechanical methods for seed selection were tried, (*a*) sieving for size and (*b*) separation under water or saline solution for density. The Upland as a group did not respond to selection for size, whereas the *desi* did. Selection by density proved useful in big-seeded varieties. The primary effects of size selection in *desi* were increased germination and higher crude and adjusted yields, while selection for density further considerably increased the yields. The effects of manuring and spacing on seed weights were studied in relation to mean seed weights of the planted seed and the trends were recorded.

FIBRES, YARNS, SPINNING, WEAVING, ETC.

523. PERIMETER MEASUREMENTS OF COTTON FIBRES IN THE PRIMARY-WALL STAGE: A METHOD AND ITS APPLICATION. By N. L. Pearson. (*Text. Res. J.*, **20**, March, 1950, p. 152. From *Text. Tech. Digst.*, **7**, 5, 1950, p. 406.) A method for obtaining information regarding perimeter differences of mature cotton fibres by measuring the perimeters of the fibres in the primary-wall stage is described. Tufts of young fibres were cut from the seed, stained, fanned out on a glass slide and dried. The width of the collapsed dried fibre equalled half its perimeter at the point measured. Perimeters were measured for nine types of cottons selected to represent a range in size of perimeters. Average perimeter values obtained were compared and found to show differences that were consistent with perimeter values for the mature fibres of the same types of cotton.

524. WAX CONTENT AS RELATED TO SURFACE AREA OF COTTON FIBRES. By P. B. Marsh *et al.* (*Text. Res. J.*, **20**, 1950, p. 288. From *Text. Tech. Digst.*, **7**, 7, 1950, p. 598.) An investigation was made to determine whether inherent or environmental differences in wax content, of sufficient magnitude to be of practical significance, exist among American Upland cottons. Several Sea Island and a few Indian cottons were tested for purposes of comparison. The percentage of wax was found to be closely proportional to surface area per unit weight of fibre as determined by the air-flow method of Sullivan and Hertel. Data are presented showing the relationship between these two fibre properties. The wax-surface relationship is not entirely free of complicating factors, as an apparent increase in wax content as measured by the Conrad method was found to occur, under some circumstances, during weathering of the fibre in the field before harvest.

525. CHANGES DURING FIBRE DEVELOPMENT: VISUAL EVIDENCE GIVEN BY SPECIAL DYEING OF COTTON ON THE SEED. By C. F. Goldthwait *et al.* (*Text. Res. J.*, **20**, 1950, p. 100. From *Text. Tech. Digst.*, **7**, 5, 1950, p. 422.) A process of differential dyeing was used to show that the initial drying of normal cotton fibres—as when the boll opens in the field—greatly affects their dyeing properties. A pronounced colour difference was observed when a lock from a nearly mature boll, opened in the laboratory, was dried and another lock, kept wet, were both dyed simultaneously in the same dye bath. The dried cotton dyed mainly red and the undried cotton dyed green. Submicroscopic changes in the cotton cellulose undoubtedly take place. Thus, the undried fibres from a cotton boll were shown to be more porous than fibres which were dried in the boll. The thin-walled (immature) fibres in ordinary cotton are similarly more porous than the thick-walled (mature) fibres, at least while in the hot dye bath. The differential dyeing effect with cotton fibres

is determined by cellulose structure in combination with specific properties of the two dyes employed.

526. Cotton Fibre: Differential Dyeing Test for Maturity; Application to Cotton Processing. American Assen. of Textile Chemists and Colorists. (*Amer. Dyes. Rept.*, **39**, 74, 1950, p. 90. From *Summ. Curr. Lit.*, xxx, 8, 1950, p. 215.) A differential dyeing test for fibre maturity is described briefly and is applied (i) to determine the "tippines" (incomplete cell wall development at the fibre ends) in cottons; (ii) to predict spinning quality of cotton; (iii) to distinguish cottons that do not dye well together; (iv) to diagnose processing difficulties; (v) to indicate effectiveness of blending judged by the number of neps; (vi) to indicate the nature of processing waste; and (vii) to provide evidence of the relationship of fineness to maturity.

(*Cf.* Abstract 396, Vol. XXV of this Review.)

527. Effect of Oil Spraying on Cotton and Spinning Process. (*Ind. Text. J.*, **60**, 1950, p. 311. From *Text. Tech. Digst.*, 7, 6, 1950, p. 430.) A relatively new product for increasing the spinning efficiency, improving yarn strength and quality, and lowering costs is described. This product (Syton W-20), which is a colloidal dispersion of submicroscopic non-crystalline silica entities, was used in these experiments employing Indian cotton. As a result of these experiments it was found that a gain in yarn strength, increased production, improved spinning efficiency and less waste were achieved.

528. The Effect of the Rate of Extension on the Strength and Extension of Cotton Yarns. By R. Meredith. (*J. Text. Inst.*, **41**, 6, 1950, p. T199.) Data available in the literature indicate that the decrease in strength of yarns or fabrics with increase in time to break is a property of the fibres themselves. The influence of yarn structure and variety of cotton on the change with time of strength, breaking extension and compliance has been investigated. It is found that (i) the strength decreases linearly with increase in log (time to break) except at short times where it becomes less sensitive to time changes; (ii) the low-twist singles yarn shows a large percentage change in strength but the same absolute change as the other yarns tested; (iii) over the range of times to break from 10 seconds to 3 hours the strength of a cotton yarn decreases by 9 per cent. for a tenfold increase in time to break: this result appears to be independent of the type of cotton; (iv) apart from the low-twist singles yarn, in which there is appreciable fibre slippage, all yarns show a maximum breaking extension for some time to break between 1 and 10 seconds, and approximately equal values at 1/100 second and 1 hour; (v) the compliance, *i.e.* extension per unit load, decreases linearly with increase in the logarithm of the rate of extension except for the singles low-twist yarn, and the magnitude of the effect is such that an increase in rate of extension of ten times produces a decrease of 7·8 per cent. in compliance, with no significant effect of variety.

The factor for converting time to break at constant load to the equivalent time to break at constant rate of extension is found to be twelve times. Results of constant load tests are found to agree with those at constant rate of extension when this factor is used. Application of the foregoing data to the correction of test results to a time to break of 10 seconds is illustrated by examples.

TRADE, PRICES, NEW USES, ETC.

529. Annual Review of the World Cotton Situation, 1949-50. (Int. Cott. Adv. Ctte., 3, April/May, 1950.) This review deals briefly with the general aspects of the cotton situation, including production, consumption, stocks, international trade and prices. Cotton statistics covering the ten-year period 1939-40 to 1949-50 are given together with a table showing the production of rayon during that period.

530. The Developing World Cotton Situation. (Int. Cott. Adv. Ctte., May, 1950.) This publication is issued by the International Cotton Advisory Committee in two parts as follows: Part A, "Detailed Analysis of Trends in, and Factors Affecting, Cotton Consumption." This section comprises reports on the following

aspects of the cotton industry: "Supply and Distribution of Cotton"; "World Cotton Consumption and Factors Affecting It"; "Cotton Consumption Patterns and Standards"; and "Synthetic Fibres, Plastic Materials and Paper as Competitors of Cotton." There is also a report on "New Uses for Cotton and Cotton Manufactures."

The second volume of the Report, Part B, entitled "Ways and Means of Increasing Consumption of Cotton and of Balancing Production and Consumption," was prepared by the Standing Committee of the International Cotton Advisory Committee in compliance with a resolution requesting that it suggest for the consideration of member governments ways and means of bringing about (*a*) an increase in the consumption of cotton and cotton products and (*b*) an adequate balance between production and consumption of cotton. It reports a discussion of measures deserving consideration with a view to developing suitable international action on cotton, including the development of underdeveloped countries, the supply of cotton at concessional prices with appropriate safeguards, exchange of longer-staple varieties of cotton for short-staple cotton, the establishment of an international cotton agreement and a multilateral exchange of commodities. It concludes with the recommendations of the Standing Committee regarding cotton consumption, production, prices and international trade.

531. WORLD COTTON PRODUCTION. (*Cotton*, M/c., 10/6/50.) The total of 31,200,000 bales represents the third largest world crop on record. It has been exceeded by the 1936-37 crop (32¼ million bales) and 1937-38 (39 million). Average pre-war consumption was approximately 28 million bales annually, in 1948-49 26½ million. The average carry-over for 1935-1939 was 17 million bales, in 1948-49 14 million. It is safe to assume that the world carry-over on July 31, 1950, will be at least 13 million bales, and world production in 1950-51 has been estimated at 29 million bales. This would indicate a supply of 42 million bales, and even if consumption should be a million bales larger than in 1948-49, a surplus of 14½ million bales is likely. In the 1920s the average world carry-over was approximately 13 million bales, and 14½ million should not prove a burdensome reserve in view of the world increase in population.

532. SKINNER'S COTTON TRADE DIRECTORY OF THE WORLD, 1950: 26TH EDITION. (Thos. Skinner and Co. (Publishers), Ltd., London. Pp. 1,554. Price £2.) *Skinner's Cotton Trade Directory* covers the cotton trade and its manufactures all over the world. The six-language index gives reference to every branch of the cotton textile industry and the section dealing with the linen trade has been augmented. In the production of the 26th edition many improvements, extensions and innumerable changes have been registered to bring it up to date.

The book gives a complete survey of the industry; details of raw cotton exporters from all cotton-growing countries, raw cotton merchants and brokers throughout the world; full information of British spinning and manufacturing companies, the general types of yarns spun and the principal fabrics manufactured; information on British piece-goods merchants includes the principal types of fabrics handled and the markets to which such goods are exported. The section devoted to trade marks covers Great Britain, Canada and the United States. The index contains well over 15,000 names, forming the introduction to an encyclopædia of the cotton industry.

Latest available statistical data cover crops, prices, world supplies and consumption for series of years. The book is valuable to all companies and firms interested in cotton in any form.

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Printed in Great Britain by
Billing and Sons Ltd., Guildford and Esher